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Impact of the Army Continuing Education System (ACES) on Soldier Retention and Performance: Data Analyses

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14. ABSTRACT *(Maximum 200 words)*: This evaluation of the Army Continuing Education System (ACES), considered the following programs: (a) Tuition Assistance (TA) (b) Functional Academic Skills Training (FAST), (c) Military Occupational Specialty Improvement Training (MOSIT), (d) Noncommissioned Officer (NCO) Leader Skill Enhancement Courses, and (e) the Armed Forces Classification Test (AFCT). The assessment of the effectiveness of these programs is based on their ability to enhance soldier performance and increase the prospects of promotion, as well as to reduce attrition and increase reenlistments.

The evaluation data came from a longitudinal administrative database that tracked a three-year accession cohort over a six-year period and an NCO database including self-reported participation in ACES programs, promotion information, and observed performance ratings. The analysis was designed to separate effects of participant characteristics from the effects of the program, and to control for differences in the opportunity and propensity to participate in ACES.

Participation in TA and FAST were associated with an increase in the probability of first term reenlistment. FAST participation was also associated with lower first-term attrition. Participation in several ACES programs showed positive effects on measures of performance and promotion potential.

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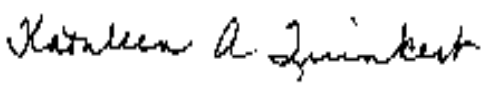
FOREWORD

The Army Continuing Education System (ACES) provides a wide range of in-service educational opportunities for enhancing the Army's human resource potential while benefiting the careers of soldiers both during and after their military service. Although there is widespread belief that participation in ACES programs results in positive outcomes for both soldiers and the Army, there has been little rigorous research addressing this question. In recent years, there has also been a growing need for the U.S. Total Army Personnel Command (PERSCOM) to acquire data showing the value of ACES programs for use in supporting the Army's training objectives.

In response to this need, PERSCOM's Education Division requested that the U.S. Army Research Institute (ARI) investigate the relationship between participation in selected ACES programs and soldier retention and performance. This effort was conducted under ARI's Studies and Analysis Program from FY00 through the third quarter of FY03. The study was carried out under contract with the Human Resources Research Organization (HumRRO) with funding assistance provided by PERSCOM. HumRRO briefed the preliminary results to the Director of Army Continuing Education System (ACES), Headquarters PERSCOM, during an in-progress review held in October, 2002.

This report presents the program evaluation methodology and findings. The compelling results clearly support the notion that participation in ACES programs has positive outcomes for both soldiers and the Army. Moreover, we believe the lessons learned from this effort can be applied to – and will be helpful for – future evaluations of ACES programs.



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IMPACT OF THE ARMY CONTINUING EDUCATION SYSTEM (ACES) ON SOLDIER RETENTION AND PERFORMANCE: DATA ANALYSES

EXECUTIVE SUMMARY

Research Requirement:

The Army Continuing Education System (ACES) provides a series of programs that are available to soldiers and, in some cases, their family members and Army civilian personnel. The mission of ACES is to promote lifelong learning opportunities to sharpen the competitive edge of the Army by providing and managing quality educational programs and services. The Education Division, U.S. Total Army Personnel Command (PERSCOM), which administers ACES, requested an evaluation to determine the value of ACES to the Total Army in the areas of retention and performance of enlisted soldiers. The evaluation consisted of two phases. The first phase included the review of relevant literature and the development of research and database development plans (Sticha, DiFazio, Dall, Handy, & Heggestad, 2000). The second phase included the development of analysis databases (DiFazio & Sticha, 2002) and the conduct of statistical analyses to determine the effects of participation in ACES programs on attrition, reenlistment, performance, and promotion. Although this report focuses on the analyses conducted in the second phase, it includes a summary of earlier activities.

Procedure:

This study provides the first major evaluation of the effects of participation in ACES programs on soldier retention and performance. It comes at a time in which there is some uncertainty regarding the effects of participation in Tuition Assistance programs on reenlistments and attrition, and little research that investigates other continuing education programs or uses other effectiveness measures. The evaluation addresses the following ACES programs: (a) Tuition Assistance (TA), (b) Functional Academic Skills Training (FAST), (c) Military Occupational Specialty Improvement Training (MOSIT), (d) Noncommissioned Officer (NCO) Leader Skill Enhancement Courses, and (e) the Armed Forces Classification Test (AFCT). The assessment of the effectiveness of these programs is based on their ability to provide soldiers with the skills that can enhance performance and increase the prospects of promotion to higher ranks, as well as to encourage them to complete their first term of enlistment and to reenlist at the end of that term.

The evaluation of these ACES programs used two sources of data. Analyses of first-term attrition and reenlistment used a longitudinal administrative database that tracked a three-year accession cohort over a 6-year period and, during the same period, recorded participation in ACES programs. Analyses of performance and promotion used a database that included self-reported participation in ACES programs by NCOs (E-4 through E-6), along with administrative information, promotion information, and observed performance ratings by supervisors. The analyses were designed to avoid problems that were identified in previous research. Most notably, because participation in ACES is voluntary, the analyses were designed to separate effects of participant characteristics from the effects of the program. Second, the analysis was designed to control for the fact that some soldiers have a greater opportunity to participate in ACES programs, because they have a longer time in service. Finally, the analyses controlled for

other variables that are known to affect the dependent variables, such as demographic variables, term of enlistment, and Military Occupational Specialty (MOS).

Analyses of attrition and reenlistment focused on participation in the TA and FAST programs. The study used a bivariate probit model to control for soldier characteristics that are correlated with both TA participation and the dependent measures of interest. Analyses of performance and promotion were based on multiple linear regression. Factors related to participation in ACES programs were included in the model to control for their possible effects.

Findings:

The results of the analyses are almost uniformly favorable to the ACES programs that were examined. The evaluation found significant positive effects of TA participation on reenlistment and first-term attrition, as well as effects on performance and promotion variables. Specific effects of participation in TA include the following:

- Participation in TA was associated with a 7-percentage point increase in the likelihood that a soldier would reenlist at the end of his or her first term of service.

- Participation in TA increased the likelihood that a soldier would complete the first year of service (conditional on completion of 6 months) and second year of service (conditional on completion of the first year) by 5 percentage points. This finding should be considered an upper bound on the estimated effect, because the analysis only partially controlled for selection bias.

- NCOs who participated in TA tended to have more promotion points, exclusive of those received directly for their civilian education. Fifteen semester hours of civilian education supported by TA was associated with increases of 6.7, 2.6, and 1.8 points for NCOs in rank E4, E5, or E6, respectively.

- NCOs in rank E5 and E6 with a greater number of semester hours supported by TA received higher performance ratings.

- Participation in TA was also associated with earlier promotion to the rank of E6.

Thus, participation in TA had a salutary effect on all of the dependent measures that were considered.

The study addressed effects of the FAST program on attrition and reenlistment. FAST participation was associated with a small, but statistically significant increase (1.4 percentage points) in reenlistment likelihood. However, it was associated with a fairly substantial, 6-percentage point decrease in annual attrition probability in both the first and second year of service. These estimates should be considered upper bounds on the true effects, because the analysis only partially controlled for selection bias.

The remaining ACES programs included in the evaluation were associated with increases in promotion points, as well as some effects on time to current rank. With one exception, the effects on promotion points were positive, though they were not statistically significant at each

pay grade. Effects on time to rank were both less common and less consistent. With the exception of TA, none of the evaluated programs had a significant effect on performance ratings.

Participation in the remaining three ACES programs included in this evaluation had the following effects.

- Participation in NCO Leader Skill Enhancement Courses was associated with a larger number of promotion points. This difference was present for all ranks, but was statistically significant for those in the ranks E4 (15.9 points per course) and E5 (8.3 points per course).

- Participation in MOSIT was also associated with greater number of promotion points. This effect was smaller than the comparable effect for NCO Leader Skill Enhancement Courses, but was significant for soldiers in grades E5 (3.4 points per course) and E6 (2.5 points per course).

- NCOs at the rank E5 who had participated in MOSIT also took a shorter time to attain their current rank. The magnitude of this difference was approximately 26.9 days per course.

- E4 soldiers who retook the AFCT had a greater number of promotion points than those who did not.

- NCOs who took the AFCT also took longer to attain their current rank. The difference was in the same direction for all pay grades, but was only statistically significant for soldiers of rank E5 (128.4 days per retake). This difference can be seen as an indication that the AFCT is serving its purpose of providing advancement opportunities to soldiers who otherwise would not qualify for them.

The magnitude of the positive effects of participation in TA on reenlistment was greater than expected, considering the results of previous studies that have employed similar controls for selection bias and opportunity to participate in TA. Specifically, the results contradict those of recent research on Navy and Marine Corps programs that found a negative relationship between TA participation and reenlistment when the opportunity to participate in educational programs was controlled. Because the evaluation data are not taken from a random sample of all enlisted personnel, the attrition and reenlistment rates and other simple sample statistics should not be viewed as Army-wide values. Nevertheless, the analyses employed statistical controls to obtain a reliable estimate of the impact of participation in selected ACES programs for the sample used in this evaluation.

This study's results show the positive effects of voluntary participation in ACES programs on the personnel ingredients of unit readiness. They further imply that ACES provides the types of self-development programs that can allow the Army to achieve transformation toward the Objective Force, and support the transformed Army in sustaining its effectiveness.

Use of Findings:

These findings provide information regarding the effectiveness of ACES programs. This information can be used in cost-effectiveness analyses to determine the value of ACES to the Army.

IMPACT OF THE ARMY CONTINUING EDUCATION SYSTEM (ACES) ON SOLDIER RETENTION AND PERFORMANCE: DATA ANALYSES

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INTRODUCTION

The Army's role as educator began in 1778 during the Revolutionary war when General Washington ordered chaplains to teach convalescent soldiers how to read. However, it was not until the 20th century that educational benefits became more widely available to both veterans and active duty servicemembers. The Rehabilitation Act of 1919 provided educational assistance to veterans who were disabled in World War I. By the end of World War II, educational benefits were offered to all veterans by the Servicemen's Readjustment Act of 1944, better known as the G.I. Bill of Rights. Further expansion of benefits for Vietnam Era veterans, passed by Congress in 1966, offered educational assistance to active duty servicemembers.

With the advent of the All Volunteer Force in 1973, the Military Services and Department of Defense (DoD) increased educational benefits as an incentive for recruitment and to encourage recruits to select critical Military Occupational Specialties (MOS). The current Montgomery G.I. Bill (MGIB), enacted in 1985, provides up to 36 months of educational assistance that can be used by both veterans and active duty servicemembers.

Realizing the need for continuing education (CE) among its members, the Services and DoD established programs to support the volunteer, off-duty educational activities of enlisted personnel and officers. The Army Continuing Education System (ACES) represents a series of educational programs that are available to soldiers and, in some cases, their adult family members and Army civilian personnel. The mission of ACES is to promote lifelong learning opportunities to sharpen the competitive edge of the Army by providing and managing quality educational programs and services. ACES includes the following programs to meet the educational needs of soldiers and to help soldiers to apply the skills learned in the Army to obtain academic credentials needed for their later civilian life.

- The American Council of Education Military Evaluations Program reviews formal military training courses to determine the extent to which they are equivalent to college courses. Soldiers can gain college credit for their military experience through this program.

- The Army Personnel Testing (APT) Program gives the soldier the opportunity to take standardized tests that are used for selection and classification purposes. Included within this program is the Armed Forces Classification Test (AFCT), which is a version of the Armed Services Vocational Aptitude Battery (ASVAB) that is given after enlistment. Soldiers take the AFCT to qualify for new Military Occupational Specialties (MOS) or other advancement opportunities.

- The Army Tuition Assistance (TA) Program helps soldiers to finance voluntary participation in off-duty postsecondary educational programs.

- The Functional Academic Skills Training (FAST) Program provides soldiers with instruction to enhance basic skills necessary for job proficiency or career progression.

- The English as a Second Language (ESL) program provides education to increase language proficiency among non-native speakers.

- Noncommissioned Officer (NCO) Leader Skill Enhancement courses provide educational opportunities for soldiers to enhance leadership abilities and pursue self-development activities that lead to certification, licensure, or degrees.

- The High School Completion Program gives soldiers and their adult family members an opportunity to earn a high school credential.

- The Servicemembers Opportunity Colleges Army Degree (SOCAD) Program allows soldiers to earn a job-related college degree at locations on or near Army installations or at a distance.

- The Army/American Council on Education Registry Transcript System provides a transcript that translates a soldier's military experience into civilian terms.

- The MOS Improvement Training (MOSIT) program gives soldiers the opportunity to learn more about certain military jobs and improve their skills through special studies courses requested by commanders based on specific unit training needs.

The ACES Program is administered by the Education Division, U.S. Total Army Personnel Command (PERSCOM). Education counselors located at installation Army Education Centers coordinate soldier participation in ACES programs by assisting soldiers to establish realistic short and long range goals and by helping soldiers make plans to obtain those goals through advisement of program availability.

PERSCOM requested an evaluation of ACES to determine its value to the Total Army in the areas of retention and performance of enlisted soldiers. The evaluation consisted of two phases. The first phase included the review of relevant literature and the development of research and database development plans (Sticha, DiFazio, Dall, Handy, & Heggestad, 2000). The second phase included the development of analysis databases (DiFazio & Sticha, 2002) and the conduct of statistical analyses to determine the effects of participation in ACES programs on attrition, reenlistment, performance, and promotions. Although this report focuses on the analyses conducted in the second phase, it includes a summary of earlier activities.

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This report begins with a summary of previous empirical studies that evaluate the benefits of participation in military CE programs, focusing on performance and turnover. It continues with a discussion of empirical and methodological problems and issues encountered in the evaluations of these programs. The evaluation approach uses lessons learned from similar studies conducted for other military services. Following the literature review, the report describes two analyses that evaluated the effects of participation in selected ACES programs on retention and performance, respectively. The retention analysis focused on TA and FAST and used first-term attrition and reenlistment as outcome measures. The performance analysis considered NCO Leader Skill Enhancement courses, MOSIT, AFCT, as well as TA. It evaluated participation in these programs based on observed performance ratings by supervisors, time to promotion to current rank, and points earned for promotion to the next rank. We describe the data sources, methods, and results for each analysis. Finally, we summarize the results and discuss their implications and potential directions for future research.

BACKGROUND

Because of the cost and visibility of military CE programs such as the Army's ACES program, the DoD and military services have sponsored several studies to ascertain the effectiveness of these programs. The studies have assessed whether CE programs can improve the performance and enhance the quality of life and retention of the enlisted personnel and officers who participate in them. The studies have focused primarily on TA programs, probably because those programs are the most expensive and most widely used of the various service CE programs. However, other programs, such as basic skills education programs, have been covered, as well. This section reviews these evaluations and identifies issues that should be addressed in the evaluation design, based on the results of past studies. Although the current evaluation of ACES focuses on enlisted personnel, we describe previous studies that examined CE programs used by officers, as well as enlisted personnel.

We reviewed the related civilian literature to identify comparable evaluations for corporate CE programs. In general, the civilian research gave useful background information regarding the availability and extent of corporate CE programs, as well as information about the motivations for participating in these programs. However, we identified no studies that related participation to turnover, performance, or other directly relevant variables. Consequently, a review of this research has been omitted from this report. The interested reader should consult the report of the first phase of this effort (Sticha et al., 2000).

The evaluation of CE programs is made more difficult by the fact that they are voluntary programs. For that reason, differences between participants and non-participants on outcome measures may reflect pre-existing differences between these individuals, rather than direct effects of the programs. Consequently, it is important to know who uses CE programs, and analyses to evaluate CE programs should be conducted in a way that corrects for the selection bias that results from the voluntary nature of CE participation. We begin our review by summarizing the motivations to participate in CE and the individual characteristics of participants. We then summarize evaluations that focus on the effects of CE participation on performance and retention. Finally, we discuss some of the implications of this research on evaluation design. The reader who wishes to skip the detailed review should proceed to the summary found on page 24.

Factors Predicting Participation in CE Programs

The literature includes two approaches for identifying the factors that predict participation in CE programs. The first approach analyzes the individual motivations to participate in CE programs. The second approach identifies demographic and other individual variables that are more or less common among participants than among non-participants. We give a brief description of relevant studies and summarize the findings from these studies on page 7.

Motivations Associated with CE Participation

What motivates a soldier to participate in off-duty, voluntary education? Soldiers might participate to: (a) improve promotion potential, (b) increase "social standing" or personal

satisfaction, (c) increase their ability to change careers or MOS, or (d) improve earnings potential in the private sector. If participation in CE is driven mainly by the desire to improve promotion potential, and thus military earnings potential, then one would expect that CE participation would lead to higher retention. On the other hand, if CE participation were driven mainly by the desire to improve earnings potential in the private sector, then one would expect CE participation to lead to lower rates of retention. Understanding the primary motivation for CE participation can result in more properly specified retention models.

Brauchle (1998) argued that although the military culture values education and encourages servicemembers to use the benefits allotted to them, a person's ability to use those benefits is greatly determined by opportunity. Opportunity to participate is not constant throughout one's military career but varies based on location, job, and military specialization. Brauchle also found that individual motivation varies throughout one's military career. He notes that servicemembers receive considerable external motivation to participate in off-duty education early in their career. As they progress, that motivation becomes more internalized.

Using the Participation Reasons Scale (PRS) developed by Catlin (1982), Grzyb (1997) identified five reasons that Army engineers (ranked lieutenant, captain or major) participated in CE: (a) professional improvement/development, (b) personal development and job security, (c) improvement of service to customers, (d) professional identity/perspective, and (e) competence and collegial interaction. Generally, military engineers resembled other professions (judges, physicians, etc.) using this scale. However there were some differences, in that leadership and functional roles, educational level and preparation, occupational specialty, rank, and years performing duties were not associated with an Army Engineer's reasons for participating in CE. Grzyb concluded that Army Engineers shared cultural elements, even set apart from the Army as a whole, that influenced their attitudes and motivation toward participating in voluntary education. For example, leaders repeatedly emphasized participation verbally, in writing and by modeling behavior by participating in off-duty education themselves. The research suggests that organizational culture (shared values) creates norms that can contribute to an individual's propensity to participate in voluntary education.

Other Characteristics Associated with CE Participation

Other research that attempts to understand or predict CE participation has used standard demographic and personal characteristics to explain CE participation, with little explanation of why those characteristics are included. For example, Becerra (1983) suggested that women and minorities, have a greater tendency than white men to view the military as a vehicle for upward socioeconomic movement. As such, it makes sense to include race and sex in models explaining CE participation. As Boesel and Johnson (1988) note, "one would expect to see a tendency among women and minority members to take advantage of the educational opportunities afforded by TA as a means of upward mobility" (p. 11). Additionally, many of the studies that analyze the effects of participation in CE on retention and performance look also at what factors predict participation in the first place to control for selection bias. (Selection bias means that program participants are systematically different from non-participants in characteristics that are correlated with the dependent measures of interest.) The results of this research identify certain characteristics that can help predict CE participation.

Several studies have shown that military service itself has had a positive effect on educational attainment for veterans (Binkin, Eitelberg, Schexnider, & Smith, 1982; Kolstad, 1986, Mason, 1970). Cohen, Segal, and Jemme (1986), found that the higher the rank one achieved in the military, the higher the level of education that was eventually achieved. However, these results seem to be confounded by the fact that promotions are partly determined by educational level achieved. Others have found that when comparing educational attainment level of white servicemembers to their civilian counterparts, those in the military attained less education,[1] but this relationship did not hold true for black and Hispanic servicemembers, who average much more education than their civilian contemporaries (Fredland & Little, 1984). Fredland and Little also found that white, black and Hispanic servicemembers had higher educational aspirations than their civilian contemporaries did. In terms of motivation to participate in educational opportunities, many argue that people are attracted to the military primarily for getting an education. Some servicemembers view their military service as one and the same with their educational aspirations (Kolstad, 1986). While this view may be widespread among servicemembers, researchers have also found that there are important intervening variables that influence educational attainment among servicemembers.

For example, Wright (1989) found that the mother's education, the father's occupation, high school grade point average, student aptitude, student high school program, and the individual's reason for entering the military were all individually significant predictors of a servicemember's educational attainment. When these factors were considered together, the two best predictors of the level of educational attainment of military enlistees were the mother's education and her educational aspirations for the enlistee. When comparing servicemembers with their civilian contemporaries, Wright found little difference in the factors that influenced educational attainment. The author suggested that the military should consider these characteristics when utilizing educational incentives for enlistment or retention.

Brauchle (1998) derived interesting results by analyzing both short- and long-term participation in educational benefits as dependent variables. Short-term participation assessed whether or not the person had attended a civilian college during the previous year. Long-term participation was defined as an increase in education level from time of entry into military service to the time of the survey, with the restriction that the individual had completed at least "some college." For both measures of participation, women were more likely than men to participate, at a rate of 1.5:1. Single servicemembers were more likely to participate in the short term than married, but in the long term, married members were more likely to participate. Army and Air Force servicemembers are more likely to participate than sailors and Marines. However, Army members participated in short-term education at higher rates than Air Force members, and Air Force members were much more likely to participate in long-term education than Army enlistees. The results of this study should be interpreted carefully, because many of the variables – including long-term participation, reenlistment intentions, and marital status – are related to time in service.

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[1] Fredland and Little (1984) note that "comparing educational levels of young servicemen with those of civilians of similar ages is biased if the data are truncated by age. If men under 22 are examined, members of the military clearly cannot have completed as much education as civilians who went directly from high school to college, and even to graduate school" (p. 212).

Two other studies that analyze the characteristics associated with CE participation focus on Navy and Marine Corps officers. Although there is some convergence between the motivation of officers and enlisted servicemembers for CE participation (i.e., promotion potential, individual aspiration, etc.), there are important differences. In general, studies show that enlisted personnel are more likely to participate in TA programs. For example, Boesel and Johnson (1988) found that Army enlisted personnel are more than three times as likely to participate. This is most likely because officers incur further obligation to the military if they use CE benefits, whereas enlisted personnel do not. Additionally, officers tend to have college degrees already. Boesel and Johnson indicated that personnel with college degrees (whether enlisted or from the officer corps) participate in TA programs at much lower rates.

Fuchs (1996), in trying to predict which Naval officers choose fully-funded graduate education (FFGE), found that those with better undergraduate records and with a more technical background were more likely to seek and be selected for graduate education. Fuchs found that married officers tended to pursue graduate education at higher rates. Additionally, those officers who were recommended to receive a promotion earlier than average (as an O1 or an O2) were more prone to seek graduate education. Wielsma (1996) conducted a very similar study focused on Marine Corps officers. He found that better performers and women were more likely to participate in graduate education than lower performers and men. He also found that commissioning source was a good predictor of graduate school participation. Naval Academy graduates were more likely to participate than those commissioned any other way.

In their evaluation of the effectiveness of Navy Voluntary Education (VOLED) programs, Garcia, Joy, and Reese (1998) identified several characteristics of the sailors who participated in these education programs. Specifically, participants were more likely to be female, married, and of Hispanic or Asian race/ethnicity. In addition, participants were younger at the time of accession and had higher aptitude than non-participants. Sea duty was found to be negatively associated with VOLED participation. Buddin and Kapur (2002) confirmed effects of sex, aptitude, and duty assignment, but found no difference due to age.

Summary

The research literature has provided a limited understanding of who participates in CE and why. Table 1 summarizes the motivations and characteristics of those who participate in CE programs, based on this literature.

Benefits of Continuing Education to the Military

The Department of Defense and the military services have studied the effects and value of providing CE to both enlistees and officers. In general, this literature suggests that CE programs are of value to the services. Most of the empirical evaluations have been directed at two criteria: performance and turnover[2].

[2] It should be recognized that these two criteria are likely to be interrelated so that addressing them separately could lead to spurious conclusions. For example, a significant relationship between CE participation and promotion may be explained by differences in retention –individuals who stay in the service longer have a greater chance of

Table 1
CE Participant Characteristics and Motivations

Motivations to Participate in CE	Characteristics Predicting CE Participation
• Military culture/norms • Opportunity to participate • Professional improvement/development • Personal development • Job security • Improvement of service to customers • Professional identity/perspective • Competence • Collegial interaction • Preparation for a civilian job	• Military service • Achieving higher rank • Race/ethnicity • Mother's education • Mother's educational aspirations for enlistee • High School GPA • Student aptitude • High School program • Individual's reason for entering military service • Sex • Marital status • Military branch • Level of contentment with military life • Promotion status • Military performance • Source of commission • Duty assignment overseas

Performance

One of the stated goals of the ACES program is to improve the effectiveness of the force. Implicit in this goal is that participation in a CE program will enable a soldier to do his or her job more effectively. In this section of our review, we look at empirical investigations of the relationship between participation in CE and job performance. In particular, we report results from six studies that considered performance as a dependent variable. Descriptive information for each of the studies is presented in Table 2. We briefly discuss each of the studies, and present a summary of the results on page 12.

Table 2 shows the variety of independent variables evaluated in these studies (presented in the last column) and the various ways that performance was operationalized, with the most common operationalization being promotion. It should be noted that using promotion as a measure of performance may exaggerate its relationship with CE participation, because that participation is often used explicitly in making promotion decisions. In addition, the table indicates that four of the studies (i.e., those with variables listed in the last column) controlled

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promotion. We provide reviews relevant to each of the criteria, and do not attempt to address such mediated relationships.

Table 2
Information on Studies Examining Promotion

Study	Service	Education Programs	Sample	Dependent Variable	Other Variables Controlled For
Alley, Mosley, Spivey, Bolton, & Mwambola (1995)	Air Force	Tuition Assistance	Enlisted, Officer	Ratings of how important CE programs are for performance and promotion	
Boesel & Johnson (1988)	All	Tuition Assistance	Enlisted, Officer	Promotion; Self-rated expectations of promotion	Armed Forces Qualification Test (AFQT) category*, education, enlistment period*, marital status, pay grade, race, sex, time in grade, time remaining in enlistment period*, time in service
Fuchs (1996)	Navy	Graduate Education	Officer	Executive officer screen; Commanding officer screen; Promotion to O6	Academic profile code, age at commissioning, commissioning source, early promotion, marital status, race/ethnicity, sex, technical preference in career field, type of undergraduate degree, utilization of graduate education at promotion board
Garcia et al. (1998)	Navy	Tuition Assistance, PACE, Academic Skills Learning Centers	Enlisted	Promotions, demotions	Education at accession, vacancies, % career on sea duty, AFQT score, age, sex, race/ethnicity, marital status, accession program, occupation
Niemiec (1987)	Air Force	CCAF	Enlisted	Early promotion vs. late promotion	
Wielsma (1996)	Marines	Graduate Degrees**	Officer	Average Performance Index; Promotion	Average performance index over career, age, sex, race, marital status, occupational community, general classification test score, composite ranking at the basic school, attendance at Naval Academy, enrollment in ROTC, participation in OTC

Notes: PACE = Program for Afloat College Education. CCAF = Community College of the Air Force.
* indicates a variable that was used in the multivariate analysis of enlisted performance, but not officer performance.
** In this study, Marine Corps officers with graduate degrees were compared to officers without degrees.

for the relationship between other explanatory variables and performance using multivariate analyses. These four studies provide the strongest evidence regarding the effects of participation in ACES programs on performance because they permit the analyst to rule out effects of other variables that may be related both to participation in ACES and to the outcome variables. Two of the four studies (Boesel & Johnson, 1988; Garcia et al., 1998) involved enlisted servicemembers, the primary focus of this analysis.

The results of these studies indicate that participation in CE programs leads to better performance. Based on a survey of Air Force officers and enlisted personnel, Alley, Mosley, Spivey, Bolton, and Mwambola (1995) found that 38% of respondents believed that the tuition assistance program improved officer job performance and 66% believed that the program improved enlisted performance. When asked more generally about advanced degrees, 24% of respondents indicated that officers with advanced degrees demonstrated better job performance than officers without such degrees. Similarly, 51% of respondents indicated that enlisted personnel with advanced degrees demonstrated better job performance than those without such degrees. When asked about promotion, 67% of respondents felt that having an advanced degree was an important factor in officer promotion, and 50% felt it was an important factor in enlisted promotion. Interestingly, however, only 39% indicated that having an advanced degree should be considered as a major factor in officer and enlisted promotion decisions. Thus, there is a general perception that possessing an advanced degree *is* important for promotion, but less agreement that it *should* be considered for promotion.

Niemiec (1987) examined the relationship between taking courses at the Community College of the Air Force (CCAF) and promotion. A median split technique was used to divide the sample of Master Sergeants into two groups, those who attained the rank early and those who attained the rank late. The results indicated a modest relationship between study at CCAF and promotion. In particular, 80% of the individuals who were promoted early had at least registered for courses at CCAF, whereas only 72% of the individuals who were promoted late had registered. In addition, 20.5% of the individuals promoted early had attained a degree, whereas only 9.9% of those promoted late had attained a degree.

Boesel and Johnson (1988) examined the relationship between participation in a tuition assistance program and promotion in a sample of 71,369 enlisted and officer personnel across three of the military Services. Of the sample, 10,718 had completed a tuition assistance course. Of the officers in the sample, 46.8% of those who had participated in a tuition assistance course indicated that that they were "Almost Sure" or "Certain" that they would be promoted, whereas 40.0% of officers who had not participated in such a course gave these responses.[3] These differences were even larger when the researchers investigated actual promotion records. In particular, Boesel and Johnson examined servicemember promotion records over an 18-month period. They found that 53.1% of servicemembers who had completed a tuition assistance course had been promoted whereas 39.1% of servicemembers who had *not* taken tuition assistance courses had been promoted in that period.

[3] These data were obtained by matching the database to the 1985 DoD survey.

To determine whether the differences in promotion could be attributable to factors other than participation in tuition assistance courses, Boesel and Johnson conducted multivariate analyses separately on enlisted and officer samples. The evaluation of the enlisted sample indicated that the relationship between tuition assistance participation and promotion was still strong after controlling for the effects of sex, race, marital status, AFQT category, education, pay grade, enlistment period, time in grade, and time remaining in enlistment period. The multivariate analysis of officer promotion, however, indicated no relationship between participation in the tuition assistance program and promotion. That is, the univariate relationship between tuition assistance participation and promotion was fully accounted for by the other variables.

Fuchs (1996) investigated the effects of participation in graduate education on the promotion of field grade Naval Officers. The study shows, overall, that participation in Fully Funded Graduate Education (FFGE) has a significant positive effect on three different officer career progression criteria, including (a) executive officer screening, (b) commanding officer screening, and (c) promotion to O-6. In the executive officer screen, for example, officers with FFGE had a success rate of 69.5% whereas those without fully funded graduate education had a success rate of 47.7%. Fuchs also found that officers who participated in graduate education later in their career progressions had a greater chance for promotion than were those who used their graduate education at earlier promotion boards. Finally, officers who obtained non-technical graduate degrees were more likely to be promoted than were those officers who received technical graduate degrees. Fuchs speculates that this is because non-technical fields of study may be more relevant to senior management duties.

Research by Wielsma (1996) evaluated performance differences between Marine Corps officers with graduate degrees and those without graduate degrees. A unique aspect of this study was the fact that it included a measure of on-the-job-performance, the average performance index, which summarized ratings included in the officers' annual fitness reports. Results indicated that those with graduate degrees had significantly higher scores on the average performance index than those without such degrees. Wielsma also evaluated the promotion rates among those officers who stayed to the O-4 promotion point. Results indicated that while 79% of those with graduate education who had stayed to the promotion point were promoted, only 65% of the officers without graduate education who had stayed were promoted. A multivariate analysis[4] indicated that graduate education was a strong, significant predictor of promotion in an initial model that did not include the performance index measure or general classification test score (a marker for cognitive ability). When these variables were added to the model, however, the magnitude of the graduate education variable was reduced, but it remained significant.

Garcia et al. (1998) examined the effects of three Navy VOLED programs – TA, the Program for Afloat College Education (PACE), and Academic Skills Learning Centers (ASLCs) – on promotions of enlisted sailors to the grade E-5. Their analysis method allowed them to separate effects directly attributable to the three programs from effects due to differences

[4] Wielsma (1996) presented two types of multivariate analyses: probit and ordinary least squares. Only the results from the probit analyses are reviewed here.

in the quality (as measured by education or aptitude) between participants and non-participants. Participation showed a positive relationship with promotion. For example, while 31% of sailors with no college credits were promoted to E-5 within 5 years of their enlistment, 43% of sailors with 15 credits accumulated through VOLED were estimated to have been promoted within the same period. Over half of this difference was directly attributable to participation, rather than to the quality of the participants. Participants were also more likely to switch to more demanding Navy jobs and less likely to be demoted than non-participants.

Summary

The studies reviewed in this section vary widely in terms of the samples used, the type of CE programs evaluated, and the ways in which they define performance. Despite this variability, however, these studies all generally indicate that CE programs have a positive relationship with performance. Although reduced in magnitude, this effect appears to hold up in multivariate analyses that control for other potentially explanatory variables. The effect would also appear to hold for both officers and enlisted personnel.

Because most of the studies reviewed used promotion as a measure of performance, the results should be interpreted carefully because CE participation is factored into the promotion decision. A relationship between CE and promotion may merely reflect the fact that participation in civilian education can give a servicemember points that are counted in determining his or her eligibility for promotion. Most of the studies described in this review mention this artifact, but none of the studies uses statistical techniques to isolate the impact of CE participation on promotions independent of the promotion points awarded for educational attainment.

Retention

Turnover is costly to the military. To replace a soldier who separates, the military incurs recruiting costs, training costs, and a loss of experience and skills. Furthermore, when soldiers separate, the military incurs permanent change in station (PCS) costs, administrative costs to out-process the separating soldier, and lost productivity during the time the soldier is transitioning out of the military. Our review of the literature (presented in this section) suggests that the ACES program may help to reduce turnover. Enlisted servicemembers leave the military for many reasons. For this study, we look at two broad categories of separations for enlisted personnel: (a) failure to reenlist at the end of a servicemember's term of service, and (b) attrition during a term of service (particularly the first term). We analyze these two retention outcomes separately because attrition and reenlistment outcomes typically occur at different stages of a soldier's career. In addition, the opportunity to participate in various CE programs changes throughout a soldier's career so the impact of participating in a specific CE program may vary for the two retention outcomes.

Reenlistment

We identified nine relevant studies on the impact of CE programs on reenlistment and officer retention. (A few of these studies look at retention in general and do not distinguish between reenlistment and attrition.) Table 3 summarizes key details of these studies. The

Table 3
Information on Studies Examining Reenlistment and Officer Retention

Study	Service	Education Programs	Sample	Dependent Variable	Other Variables Controlled For
Alley et al. (1995)	Air Force	Tuition Assistance	Enlisted, Officer	Rating of relationship of CE to retention and satisfaction	
Boesel & Johnson (1988)	All	Tuition Assistance	Enlisted, Officer	Intention to reenlist, reenlistment	Armed Forces Qualification Test (AFQT) category*, education, enlistment period*, marital status, pay grade, race, sex, time in grade, time remaining in enlistment period*, time in service
Brauchle (1998)	All	Tuition Assistance	Enlisted	Intention to reenlist	Education level at entry, education level at time of survey, enlistment period, marital status, pay grade, race, sex, time remaining in enlistment period, time in service, civilian job opportunity, job satisfaction, satisfaction with military life, desire to participate in off-duty education, spouse support for reenlistment,
Buddin & Kapur (2002)	Navy, Marine Corps	Tuition Assistance	Enlisted	Reenlistment	Sex, age, race/ethnicity, AFQT category, Education level, marital status, dependents, occupation, off-base housing, location,
Burtzman (1994)	Navy	FFGE	Officer	Annual retention rate	
Garcia et al. (1998)	Navy	Tuition Assistance, PACE, Academic Skills Learning Centers	Enlisted	Reenlistment or extension	Education at accession, selective reenlistment bonus type, pay grade at decision point, scheduled for promotion, sea duty or next tour ashore, AFQT score, age, sex, race/ethnicity, number of dependents, marital status, unemployment rate, occupation
Garcia, Arkes, & Trost (2002)	Navy	Tuition Assistance, PACE, Academic Skills Learning Centers	Enlisted	Continuation for 6 years	Education at accession, AFQT score, age, sex, race/ethnicity, number of dependents, marital status, unemployment rate, occupation
Simutis, Ward, Harman, Farr, & Kern (1988)	Army	BSEP	Enlisted	Retention rate, attrition rate	
Wielsma (1996)	Marine Corps	Graduate Degrees**	Officer	Staying in service to O-4 promotion point	Average performance index over career, age, sex, race, marital status, occupational community, composite ranking at the basic school, attendance at Naval Academy, enrollment in ROTC, participation in OTC

Note: FFGE = Fully-funded graduate education. BSEP = Basic Skills Education Program.
* indicates a variable that was used in the multivariate analysis of reenlistments, but not officer retention.
** in this study Marine Corps officers with graduate degrees were compared to officers without degrees.

analyses of enlisted members use reenlistment outcomes as the outcome measure. The analyses of officers use overall retention as the outcome measure. The studies primarily focused on participation in TA programs; however, two looked at participation in graduate education; and one focused on basic skills education. Six of the nine studies used multivariate analysis to isolate the impact of CE participation on retention while controlling for other explanatory variables (five of these studies focused on enlisted servicemembers). The table shows the other variables that were controlled for in the multivariate analyses. The following description briefly examines each of the nine studies. A brief summary is presented on page 17.

In their survey of officer and enlisted professional military education students, Alley et al. (1995) asked several questions concerning the perceived influences of the tuition assistance program on retention. Results indicated that 65% of respondents agreed (rated the item as "Strongly Agree" or "Agree") that a major reason enlisted people stay in the military is because of the educational opportunities (compared to 10% that indicated "Disagree" or "Strongly Disagree"). The trend results were somewhat different for officers. That is, only 20% of respondents agreed that officers stay in the military because of the educational opportunities (compared to 33% who disagreed).

In terms of job satisfaction, which some argue is connected to retention, Alley et al. (1995) found that respondents felt that tuition assistance improved the job satisfaction of both officers and enlisted personnel. Specifically, 39% agreed that tuition assistance improved officer job satisfaction (11% disagreed), and 68% agreed that it improved enlisted satisfaction (6% disagreed).

Boesel and Johnson (1988) examined the relationship between participation in a tuition assistance program and probability of reenlisting. Based on data from a 1985 DoD survey, they found that 13.4% of the people in their sample that had participated in tuition assistance planned to leave the service at the end of their current commitment. In contrast, they found that 23.6% of people in their sample who had *not* participated in tuition assistance planned to leave the service.

This difference was even more dramatic when actual reenlistment was evaluated. Of the people who had participated in tuition assistance, 18.6% had left the military in the 18-month period examined by Boesel and Johnson. The failure to reenlist rate was much higher (35.8%) among people who did not participate in TA. The strong significant relationship between participation in TA and reenlistment was found among both enlisted and officer personnel even after controlling for the effects of other explanatory variables.

A study by Brauchle (1998) was designed as a replication and extension of the Boesel and Johnson (1988) study. Brauchle used data from a 1992 DoD survey to evaluate the relationship between ever having participated in CE and self-reported intention to reenlist.[5] The correlation between the CE participation measure and the intention to reenlist was found to be

[5] This measure of CE participation was created based on survey responses to questions concerning education level at time of entry (into the military) and the education level possessed at the time the survey was completed. The participation measure was defined as an increase in education level (from entry to the time of the survey), with the restriction that the individual had completed at least "some college."

weak (accounting for only 3% of the variation in the intention to reenlist), but statistically significant. The results of multivariate analysis were similar; long-term participation continued to be a significant predictor of the intention to reenlist, but the amount of variance accounted for by this variable was relatively small.

In an extension of the Boesel and Johnson (1988) analysis, Brauchle included additional measures in his multivariate analyses, including job satisfaction, satisfaction with the military way of life, and civilian employment prospects. He found that this more complex model explained almost 41% of reenlistment behavior compared to the replicated model that explained only 25%. The best predictor of reenlistment intention in the more complex model was satisfaction with military life, which explained 26% of reenlistment behavior. In this model, ever having participated in off-duty education accounted for slightly less than 8% of the variation in intent to reenlist. Though off-duty education participation did not account for a large percentage of a person's reasons to reenlist, the author nevertheless concluded that reenlistment rates were higher among those who do and who want to participate in off-duty education (even if they do not participate), controlling for education level.

Brauchle noted that members with longer service were both more likely to have participated in a CE program during their military career and more likely to reenlist. Consequently, he assessed a short-term measure of participation in a CE program – i.e., having participated during the previous year. Brauchle reported a very small, but significant negative relationship between this variable and the intention to reenlist. He speculated that those who plan to leave the service take advantage of the opportunity to receive financial assistance and prepare for the civilian job market in greater numbers than do those who intend to remain in service. These results underscore the importance of examining as much of a servicemember's history as possible in evaluating the relationship between CE participation and reenlistment.

In addition to their analysis of promotion described previously, Garcia et al. (1998) examined the association of participation in three VOLED programs with reenlistment, using data from active-duty enlisted sailors who enlisted in FY 1992 for a 4-year term of service. Their measure of retention included reenlistments and extensions of more than one year. Sailors who did not reenlist included both those who left at the end of their term of service and those who left sometime before the completion of their enlistment contracts. To control for selection bias, Garcia et al. employed a two-step technique that involved the development of linked probit models that predicted participation in VOLED and retention, respectively. The results of the analysis indicated participation in VOLED increased reenlistment probabilities. A total of 31% of sailors who did not participate in VOLED reenlisted. However, the results of the analysis indicated that 37% of those with 15 credit hours would reenlist, as would 55% of those with 60 credit hours. More recently, Garcia, Arkes and Trost (2002) reported a similar analysis of the FY 1992 accession cohort, with similar results. According to that analysis, participation in a VOLED program increased the likelihood of staying in the Navy for 6 years by nearly 13 percentage points.

A recent analysis by Buddin and Kapur (2002) cast doubt on the earlier findings of Boesel and Johnson (1988) and the analyses by Garcia et al. (1998, 2002) on the relationship between participation in TA and reenlistment. Buddin and Kapur argued that in these previous analyses, servicemembers who did not reenlist had less opportunity to participate in TA

programs, because their time in service was shorter. Furthermore, these studies do not distinguish between servicemembers who left at the end of their term of service from those that left before completing their enlistment obligation. Buddin and Kapur reestimated the models used in the earlier studies, but controlled for differences in the opportunity to use TA between those who reenlist and those who leave. They found that after controlling for differences in the opportunity to participate in TA, participation was associated with a reduced likelihood of reenlistment.

Buddin and Kapur then used two different approaches to examine the relationship between TA participation and first-term reenlistment for enlisted personnel in the Navy and Marine Corps during FY 1997 and the first half of FY 1998. The first approach estimated a bivariate probit model that simultaneously predicted TA participation and first-term reenlistment. This technique corrects for selection bias that may occur because the decision to take classes supported by TA and the decision to reenlist are not independent. The results of these analyses showed a non-significant negative effect of TA on retention for the Marine Corps and a significant negative effect of about 9 percentage points for the Navy. The second approach compared the retention behavior of TA participants with that of a matched group of non-participants. The results of this analysis showed that TA participation was associated with a 4-percentage point reduction in reenlistment likelihood for the Marine Corps and with an 11-percentage point reduction for the Navy.

As a part of a study on utilization of FFGE in the Navy, Brutzman (1994) examined the relationship between FFGE and retention. Using a longitudinal database, she compared the percentage of FFGE officers who left the Navy to the percentage of non-FFGE officers who left the Navy for each of the years 1981 to 1993 (with the exception of 1983). This comparison indicated that the percentage of FFGE officers leaving the Navy was lower in every year. Across the years, an average of 4.8% of all FFGE officers left per year whereas an average of 11.2% of non-FFGE officers left. She also indicates that "73.1% of all FFGE officers remained in the service past their commitment" (p.53), which is a retention rate nearly double that in the non-FFGE groups.

In his comparison of Marine Corps officers with and without postgraduate education, Wielsma (1996) also considered the effects on retention. In this study, retention was defined as staying in the service to the O-4 promotion point. It was found officers choosing to stay in the Marines are more likely to have obtained a postgraduate education. Although only 7% (n = 78) of the sample had graduate degrees, 15% (n = 67) of the people who stayed to the O-4 promotion point had graduate degrees. Looking at this analysis differently, 83% of those with graduate education stayed to the O-4 point. This percentage stands in dramatic contrast to the 38% of those without graduate education who stayed. Wielsma also conducted a multivariate analysis to evaluate this effect. In this analysis, graduate education was a strong, significant predictor of retention in an initial model that did not include the performance index measure (the general classification test score variable was not included in this analysis). When the measure of on-the-job performance was added to the model the magnitude of the graduate education variable was reduced, but it remained statistically significant.

Regarding basic skills education, research by the U.S. Army Research Institute (ARI; Simutis, Ward, Harman, Farr, & Kern, 1988) indicates that the Basic Skills Education Program (BSEP) also dramatically increased reenlistment rates, while decreasing attrition. For example,

they found that a sample of 3,271 BSEP graduates had lower attrition rates (3.4% vs. 34.6%) and higher reenlistment rates (37.9% vs. 11.0%) than a comparison group (n = 3,328) who did not participate in BSEP.

Summary. Most research has focused on TA, while a smaller amount has addressed FFGE and basic skills education. The literature provides inconclusive findings regarding the overall effect of TA participation on reenlistment probability. The two studies that best controlled for other variables, including differences in the opportunity to participate in TA (Brauchle, 1998; Buddin & Kapur, 2002) show a negative relationship between participation and reenlistment. Other studies indicating that those who participate in TA remain in military service longer than those who do not, suffer from methodological problems. Furthermore, differences across studies in the populations analyzed (e.g., officers, junior enlisted, senior enlisted), outcome measures (e.g., reenlistment, overall retention), and statistical methods make it difficult to extrapolate the findings to soldiers and, in particular, soldiers in their first enlistment. The small amount of research on other CE programs, namely FFGE and basic skills education, has shown a positive relation between participation in these programs and officer retention or reenlistment.

Attrition

Attrition is a subset of total separations and is an issue that pertains mainly to enlisted personnel in their first term of service. Although numerous studies have analyzed the causes of attrition in the military, to our knowledge the study by Simutis et al. (1988) described in the previous section is the only one that investigated the effect a CE program may have on reducing attrition. One reason for the paucity of research in this area may be that a large percentage of attrition occurs early in the initial enlistment. Consequently, many soldiers who separate early have not had the opportunity to become informed about, or participate in, the military's CE program. The BSEP program (currently known as FAST) evaluated by Simutis et al. (1988) was available to a soldier early in his or her career, and consequently would be more likely to reduce attrition.

Attrition can occur for numerous reasons, some of which are beyond the military's control. Consequently, it is useful to construct two working definitions of attrition—"voluntary" attrition and "involuntary" attrition. Voluntary attrition is defined as those separations that are the result of the soldier's actions (e.g., the decision to leave, poor performance or unacceptable behavior). Involuntary attrition is defined as those separations that are not the result of choice (e.g., death, and medical and psychological disability). While most reasons for separation can be classified unambiguously as either voluntary attrition or involuntary attrition, the classification is not straightforward, and may be arbitrary, in many cases.[6]

[6] There is some concern whether the Army's separation data are sufficiently reliable to separate attrition into meaningful categories. For example, a soldier might receive a medical discharge when the true reason for separating was not medical. To the extent possible, involuntary separations (e.g., death) that can be identified should be excluded from the analysis.

The main reason that an analysis should distinguish between voluntary and involuntary attrition is to build a causal model of the attrition process that can accurately capture the relationship between attrition and its explanatory variables. Previous research has shown that this relationship differs by reason for separation (see, for example, Klein and Martin, 1991). Most research has focused on the issue of voluntary attrition.

Laurence, Naughton and Harris (1995) reviewed the attrition literature and discussed the known and suggested causes of first-term attrition. Below, we summarize the explanatory variables used in previous analyses of attrition.

- *Contract length*. Hogan (1979) showed that longer contract length is positively correlated with attrition. However, estimation of the magnitude of the theoretical relationship between contract length and the probability of separating prior to contract completion is complicated by the likelihood that soldiers with a higher preference for military life—and thus at lower risk of attrition – may be more likely to choose contracts of greater length.

- *Education (as measured by years completed, diploma, and General Equivalency Diploma [GED])*. Many studies have found that having a high school diploma is the best single predictor of completing the first-term enlistment (as summarized by Laurence et al., 1995). However, the reason why high school graduates are less likely than non-graduates to separate early is unclear.[7]

- *Mental ability*. Enlistees with higher AFQT scores are less likely to separate early than those with lower scores (see, for example, Flyer and Elster, 1983; Laurence, 1984, 1987; Klein and Martin, 1991). In addition, AFQT has been found to be a better predictor of attrition among high school graduates than among non-graduates, and for whites versus blacks (Elster and Flyer, 1982).

- *Military occupation and skills*. Past studies have found differences in attrition rates between occupational specialties in the military (e.g., Fernandez, 1985; Finstuen & Alley, 1983; and Rosenthal & Laurence, 1988). Reasons may be that some jobs are more arduous or onerous than others are. In addition, in some occupations soldiers are learning skills that are more marketable in the civilian workforce. Also, educational opportunities may be limited for soldiers holding certain specialties.

- *Race/ethnicity*. The literature shows mixed findings on the relationship between race/ethnicity and attrition. Cooke and Quester (1988) found that relative to members of racial or ethnic minority groups, whites are more likely to be discharged for administrative reasons and less likely to be discharged for disciplinary actions. Klein and

[7] Plausible explanations are that ability and personal skills that contribute to a successful graduation are the same factors that contribute to the successful completion of one's enlistment contract. Consequently, a high school diploma not only represents a level of academic success, but also represents unobservable characteristics such as ability and degree of discipline. Laurence (1987) found that attrition rates of soldiers with a GED more closely resemble attrition rates of non-high school graduates than of graduates.

Martin (1991) found that all else being equal, white recruits are more likely than their black counterparts to separate early both for medical and adverse reasons.

- *Sex*. Various studies have found that women are more likely to separate early than men (e.g., Flyer and Elster, 1983). Compared to men, women are more likely to separate for medical reasons (often for pregnancy) and less likely to separate for disciplinary-related actions.

- *Supplemental education benefits*. Hogan, Smith and Sylwester (1991) found that supplemental educational benefits offered under the Army College Fund have a small, negative effect on attrition. However, they find that the relationship is not statistically different from zero.

- *Age at Accession*. Past studies have shown that the relationship between age at accession and attrition is not especially strong, although there is some evidence that younger soldiers are more likely than their older counterparts to separate because of behavioral problems and older soldiers are more likely than younger soldiers to separate for medical reasons (Flyer & Elster, 1983).

- *Marital status and number of dependents.* Both marital status and number of dependents can vary across soldiers and over time. Past studies have been fairly consistent in finding that married soldiers are more likely to separate early than single soldiers, although the relationship may be weak (Klein and Martin, 1991). This pattern holds for both male and female soldiers. Little research has been conducted to determine whether attrition is correlated with having dependents or with the number of dependents.

- *Economic conditions*. The ratio of military to civilian pay and the unemployment rate are two possible explanatory variables to control for economic conditions. Kleinman and Zuhoski (1980) estimated the effect of pay and other determinants on Navy pilot attrition. They found that pilot attrition increased as the pay of civilian pilots increased relative to military pay.

Methodological Issues and Data Limitations

The empirical studies that we reviewed encountered numerous methodological issues and data limitations that are relevant to this study. Failure to address these issues could potentially reduce the reliability of the findings. As discussed previously, participation in CE programs is voluntary. Many of the same factors that help determine program participation also influence the job performance and retention outcomes that we desire to analyze. To obtain unbiased estimates of the impact of CE program participation on the outcomes of interest, one must control for the non-random nature of program participation.

Estimating the value added by CE program participation is made difficult by the confounding relationship between the outcomes of interest (i.e., recruiting, performance, and retention) and the attributes of individuals in the sample. Methodological issues and data limitations further complicate the analysis. In this section, we describe the methodological and data issues encountered in the empirical literature. We give a brief description of each issue and

describe the techniques used in past studies to address these issues. These issues are (a) evaluation design and selection bias, (b) data limitations, and (c) sampling issues.

Evaluation Design and Selection Bias

The studies we reviewed all used a retrospective evaluation design where the education programs were evaluated using historical data and where the evaluator had little or no input into the process by which individuals were selected to participate in the education program evaluated. Because virtually every soldier is eligible to participate in the major CE programs under ACES and because participation in the CE programs reviewed is voluntary, an experimental design that randomly assigns soldiers to participate in a CE program is not possible. Controlling for the voluntary nature of program participation is vital to isolating the CE programs' impact on the outcomes of interest. Because a controlled experiment with random assignment generally is not feasible, researchers have used "quasi-experimental" evaluation designs to mitigate the effect of selection bias. A quasi-experimental design controls for factors that affect both assignment to the test group (i.e., CE program participation) and the outcomes being analyzed. The two main approaches to conduct a quasi-experimental design are multivariate regression analysis and matched-pairs analysis. With the exception of the study of Buddin and Kapur (2002), all of the empirical studies that we reviewed use the former approach.

The purpose of using a multivariate regression is to isolate the effect of each explanatory variable on the dependent variable. Because ACES participation is voluntary, and because many of the factors that determine program participation are also predictors of performance and retention, the estimates from the regression model may be biased unless one controls for self-selection. Several approaches have been suggested in the literature to mitigate the problem of selection bias. These approaches are not necessarily mutually exclusive.

The first approach is to estimate a regression model that contains all observable soldier characteristics that help determine program participation (i.e., control variables) and explanatory variables that affect the outcome of interest.[8] Inclusion of the control variables helps minimize the problem of "selection" bias, while inclusion of the explanatory variables helps minimize the problem of "omitted" variable bias. Factors such as pay, bonuses, and MOS that may affect the outcomes of interest should be included in the regression analysis. Even though these factors may be uncorrelated with program participation, including them in the model will reduce the residual variance and thus increase the precision of the estimated program effect. To the extent that one can successfully include the variables that are correlated with participation and that also affect retention and promotions, one will obtain an unbiased estimate of the program effect, using participation as the "treatment" indicator. However, if one omits some variables that are correlated with participation and that affect outcomes, the estimated program effect may still suffer from selection bias.

[8] In the econometrics literature on program evaluation, this is sometimes called "selection on observables" in that observable, measurable factors affecting both participation and outcomes are explicitly controlled for by including them in the multivariate estimation equation.

The second approach requires that two regression models be estimated. This approach is sometimes referred to as the "Heckman two-step procedure" (Heckman, 1979). The first step is to estimate a probit model to predict the probability of program participation. This probability is manipulated to form a ratio, known as the "Inverse Mills Ratio," that is used as a control variable in the second regression. The second regression contains all the explanatory variables hypothesized to affect the dependent variable, in addition to the Inverse Mills Ratio. This approach was used by Boesel and Johnson (1988), Garcia et al. (1998), and Wielsma (1996). A variation of this approach is to simultaneously estimate both the probability of CE program participation and the outcome of interest. For example, Budding and Kapur (2002) estimate a bivariate probit model.

A third approach is a matched-pairs analysis. For this approach, the researcher first identifies a sample of individuals who participated in the program and thus self-selected into the test group. To form a control group, the researcher identifies a "match" for each individual in the test group using the attributes of the individual to make the match. A major problem with this approach is that matching is difficult, and an inaccurate matching scheme will lead to inaccurate results. An approach that combines matching with regression approaches, such as that used by Buddin and Kapur (2002) can help to verify the accuracy of the matching scheme.

Data Limitations

The studies we reviewed encountered several data limitations that are relevant to an evaluation of the ACES program. These issues are sample attrition, censoring, and measurement error.

Sample Attrition

Sample attrition occurs when members leave the sample before the end of the data collection period. Failure to control for sample attrition may bias the findings. Below we provide a brief description of the issue as discussed in the literature.

Consider the following example that illustrates how sample attrition may affect the evaluation of ACES. Suppose one wishes to design an evaluation of the effect of CE program participation on promotions. The researcher will collect information on a sample of soldiers who participate in the program (i.e., the test group) and soldiers who did not participate in the program (i.e., the control group). Then, the researcher will determine if soldiers in the test group were more likely to be promoted during a given period of time (e.g., within two years after participating in the education program). Some soldiers, however, may leave the military before the end of the data collection period. Thus, one never observes whether the soldier would have been promoted if the soldier had stayed in the military. If the reason for leaving is related either to participation in the CE program or to the outcome of interest, then sample attrition may bias the findings.

In this example, if a soldier thinks he or she will likely be promoted, then the soldier may decide to stay. Alternatively, if the soldier thinks he or she will not be promoted, then the soldier may decide to leave. If ACES participation increases the likelihood of promotion, then failure to control for this sample attrition would cause one to overestimate the impact of ACES on

promotions. In this hypothetical scenario, soldiers who do not participate in ACES have a lower probability of promotion and are thus more likely to leave the sample through attrition. If soldiers who left the sample through attrition are dropped from the analysis, then the estimated ACES program effect could be biased high. Counting the soldiers who left the sample through attrition as "not promoted" would also bias the findings.

Censored Data

The problem of censored data is a general problem that includes sample attrition as a special case. Censoring occurs when an event of interest (e.g., participation in a CE program, promotion, or reenlistment) cannot be observed, either because it occurs outside the period over which the data are obtained, or because other events make this variable impossible to detect. This concept is relevant to the evaluation of ACES because complete data on ACES participation is unavailable before 1999. Thus, an evaluation of ACES programs would be affected by "left" censoring, which occurs when the event takes place before the observation period. "Right" censoring occurs when the event happens after the observation period. Sample attrition can be viewed as an example of censoring in which the censoring event occurs during the observation period. Similarly, for the reenlistment analysis, some solders in the analysis file have Expiration of Term of Service (ETS) dates that fall outside the period of observation. To control for censoring, the analysis sample includes only first-term enlistments located at installations where data on ACES participation was being collected during the period of FY 1996 to FY 1998.

Measurement Error

Measurement error occurs when precise measures of a particular variable of interest may not be available. This may occur because no physical measure corresponding to the variable of interest is available (e.g., cognitive ability or experience), or because the variable is not measured consistently. The bias introduced by measurement error can be severe (Green, 1997). Four sources of measurement error were evident in the studies we reviewed.

The first source of measurement error is associated with CE program participation. Measurement error in this variable can occur for many reasons – including poor records of members' CE program participation. If members who participated in a CE program are recorded as non-participants, either because of poor data recording or censoring, then the effect is to attenuate (or bias towards zero) the measured ACES effect on the dependent variable. A previous study of ACES (Brink, Newman, Spurgeon, & Stock, 1981) found missing ACES participation data to be a common phenomenon.

The second source of measurement error is associated with the measure of retention. At issue is how a separation is categorized. In general, evaluations of retention are interested in determining what factors can decrease voluntary turnover. Thus, these studies often omit involuntary separations (e.g., employees who are fired or who leave for death or medical reasons). Some survey respondents may not accurately categorize their separation as voluntary. That is, they may give more socially desirable reasons for quitting than do their employers. Likewise, reasons for separation in administrative databases may not be completely accurate.

Job performance measures represent a third source of measurement error. As discussed previously, measures of job performance are not readily available for soldiers. Furthermore, measures of job performance will vary by the type of work soldiers perform—which can differ substantially across soldiers. Consequently, the studies we reviewed that analyze the impact of CE participation on job performance use promotions (and in some cases demotions) as a proxy for performance. Although promotions generally are indicators of good performance, there are numerous factors other than performance that are determinants of promotions. Some of these variables are observable and can be controlled for in a regression model (e.g., time in grade, MOS). Other factors are less observable to the researcher (e.g., number of promotion positions available). The main issue, though, is that because promotions are an imprecise measure of performance, studies of the impact of CE participation on promotions do not capture the "true" relationship between CE participation and job performance.

Finally, measures of cognitive ability represent a fourth source of measurement error. Soldiers' ability is an important determinant of the propensity to participate in a CE program and the likelihood of promotion. Researchers have used different variables as proxies for ability. For example, the most common measures include AFQT score (e.g., Garcia et al., 1998; Boesel & Johnson, 1988), high school diploma (e.g., Garcia et al., 1998), early promotion or special qualification by a review board (e.g., Fuchs, 1996; Talaga, 1994), and grade point average (e.g., Fuchs, 1996; Talaga, 1994). These variables are only proxies for cognitive ability, so the "true" relationship between aptitude and the dependent variable of interest is unknown and the estimated relationship is biased towards zero – or no effect (Green, 1997). Unfortunately, a poorly measured variable can bias (in unknown directions) the estimates for other explanatory variables in the multivariate regression model. Although including a variable measured with error in the regression model reduces the reliability of the estimated relationship between CE program participation and the outcome of interest, omitting the variable could cause a worse problem.

Sampling Issues

Two sampling issues addressed in the literature that are relevant to this study are sampling error and sample sources.

Sampling Error

Most of the military studies that we reviewed were based on relatively large samples. For example, Boesel and Johnson's (1988) study of DoD's Tuition Assistance program was based on nearly 100,000 members of the military. However, when one desires to analyze subsets of the sample, sampling error becomes an increasingly important issue. For example, when Boesel and Johnson analyzed only those members in the Navy who had participated in the TA program and who responded in the survey that they were "almost sure" or "certain" of promotion, then the sample size dropped to 84. In general, larger samples result in more precise estimates of the impact of CE participation on the outcome of interest. That is, one is more confident of findings that are based on larger samples than findings based on smaller samples.

Sample Sources

The primary source of information for the military studies we reviewed was administrative databases. In general, the authors of the studies merged administrative records on CE program participation with a "master" file that contained information on soldiers' career history. The master file used in the analysis typically contained information on the soldiers' demographic characteristics, job characteristics, and the outcome of interest (e.g., promotion or retention) for a cohort of soldiers.[9]

One of the main limitations of administrative data is that vital information on soldiers' unobservable attributes (e.g., intentions, perceptions, and satisfaction) is not available. As a result, the findings of various studies are clouded by factors that the researchers cannot control. Boesel and Johnson, in their study of DoD's Tuition Assistance program, had the unique opportunity to merge administrative records with the 1985 DoD Survey. This allowed the authors to compare the outcomes of interest (i.e., reenlistment and promotion), by TA participation status, stratified by how survey respondents answered various questions in the survey. They found, for example, that soldiers who had never participated in a TA program were intending to leave the military at higher rates than soldiers who had previously participated in a TA program. Their findings from this analysis are likely biased, however, for failing to control for factors that are correlated with both participation in a TA program and intention to remain in the military – such as time in service.

Summary and Implications

The research literature provides limited coverage of CE programs, focusing primarily on TA and basic skills programs. Within this limited range, the research gives a relatively positive picture of the effects of participation in these programs on performance, and a mixed picture regarding the effects on retention. This section summarizes the research findings, describes some of the limitations of these findings, and makes recommendations for the evaluation of ACES based on these results.

CE serves both organizational and personal goals. A program such as ACES provides an opportunity for a soldier to improve performance on his or her military occupation and to better prepare for later civilian employment. Given the divergent goals that may be served by CE, it is not surprising that the motivations for participation are complex and include both internal and external factors. Despite the divergence in motivations, it seems to be a fair characterization of the situation that those who participate in CE tend to be better qualified and more highly motivated soldiers (or employees) than those who do not. This difference confirms our concern that the evaluation plan must control for selection bias.

A positive effect of CE on performance is reflected in the opinions of officers and enlisted personnel, promotion rates, and actual performance ratings. Servicemembers indicated that they believed that CE would improve job performance, particularly for enlisted personnel.

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[9] A cohort is typically defined by when soldiers entered the military or were eligible for a specific event (e.g., reenlistment or promotion), or by military rank.

Although there is little data to judge whether these perceptions are accurate, the effect of participation in CE on promotion was positive, even after controlling for the effects of moderating variables. In correspondence with servicemember opinions, the effects on promotion rates were stronger for enlisted personnel.

Turnover covers both reenlistment and attrition. Regarding reenlistment, existing research paints a mixed picture regarding whether participation in CE (particularly TA) affects the likelihood that servicemembers will reenlist. The most methodologically sound studies suggest that participation in TA either has no effect or has a modest negative effect on the likelihood of first-term reenlistment. There are no recent studies of the impact of TA on first-term attrition.

Because basic skills education can occur early in a soldier's career, it has the potential to affect attrition, most of which also occurs early. We suspect that other programs, such as TA would not have a substantial effect on attrition, which tends to occur before the soldier has had much opportunity to participate in TA.

Several factors limit the generality of the findings of past research. First, with few exceptions, the existing research evaluates voluntary, postsecondary education programs, most notably TA. Although some of the relationships that were found for TA programs were confirmed for the BSEP program, no research was found addressing other ACES programs, or their counterparts in either the other Military Services or the civilian workplace.

Second, in several studies reviewed, the authors combined data on servicemembers in different stages of their military career instead of estimating different models for different types of members. Assuming that the relationship between CE participation and the outcome of interest is fixed across all types of servicemembers could bias the findings. For example, the motivation for participating in a CE program may be much different for a soldier in his or her first enlistment term than in his second enlistment term. Consequently, the relationship between the dependent variable (e.g., reenlistment) and the explanatory variables (including CE participation) may be different for the different types of members. An analysis of the retention effects of CE participation for members in their first enlistment could have significantly different findings than an analysis of the retention effects of CE participation for members in their second enlistment.

Third, many of the earlier studies suffer from data limitations and/or methodological problems such as failure to adequately control for selection bias and failure to control for differences in opportunities to participate in CE programs. Available evidence indicates that the individuals who participate in CE programs tend to be better qualified and more highly motivated than non-participants. Consequently, effects of CE participation on retention or performance are reduced when attempts are made to control for selection bias. Results of studies in which selection bias was not controlled for should be viewed with caution. The simplest presentation of results, in this case, may be misleading.

EFFECTS OF ACES PARTICIPATION ON ARMY RETENTION

Background

Does the opportunity for military personnel to participate in voluntary education programs available affect their propensity to remain in the military? Garcia et al. (2002) found that sailors who participated in the Navy's TA program had overall 6-year retention rates approximately 11 to 13 percentage points higher than retention rates for sailors who did not participate in TA, and the authors attribute this retention effect to the TA program. A study by Buddin and Kapur (2002), however, in an analysis of Navy and Marine Corps programs obtained results that are strikingly different from those of Garcia et al. They found that TA participation actually reduced the propensity of military personnel to remain on active duty. Buddin and Kapur argued that the observed positive relationship found by Garcia et al. (as well as the observed positive relationship found by Garcia and Joy [1998] and Boesel and Johnson [1988]) was the result of inadequately controlling for the opportunity to participate in TA.

The Army provides soldiers the opportunity to participate in numerous voluntary education programs during different stages of their career. This analysis focused on two voluntary programs (TA and FAST) that were judged most likely to have an impact on first term reenlistment and first term attrition. For a voluntary education program to affect retention, the program must be attractive enough to encourage participation, and influential enough to change soldiers' behavior either by creating incentives to remain in the military or by enhancing quality of life in the military. Consequently, one would expect the potential retention effect of a program to be correlated with its size – in terms of both devoted resources and participation. TA and FAST are among the largest of voluntary education programs available to soldiers earlier in their career. Two retention measures analyzed are (a) whether soldiers complete their first enlistment and (b) whether soldiers who complete their first enlistment reenlist.

We focused on soldiers in their first enlistment for two reasons. First, separation is of greater concern during the first enlistment because, compared to soldiers in their second or greater enlistment, soldiers in their first enlistment are less likely to complete their initial obligation and are less likely to reenlist. Second, by focusing on soldiers in their first enlistment stationed at selected military installations, a more complete record of participation in TA and FAST was available. One problem with focusing on soldiers in their first enlistment, however, is that soldiers will have had limited opportunity to participate in TA – especially soldiers who attrit early in their enlistment. We attempted, however, to ensure that those who stayed and those who left had the same opportunity to participate.

To answer the question of whether TA and FAST programs affect the propensity of soldiers in their first enlistment to remain in the Army requires an understanding of *who* participates in these programs, *when* soldiers participate in these programs, and *why* soldiers participate in these programs. Soldiers who participate in FAST generally do so early in their first enlistment while TA participants generally start after the first year of enlistment. Consequently, the TA program has limited potential to reduce first term attrition that generally occurs before solders have the opportunity to participate in TA.

Soldiers have different motives for participating in voluntary education programs such as TA and FAST, and these motives likely differ by type of program. Programs such as TA allow soldiers to enhance their education, and the education gained is both recognized by and readily transferable to the civilian sector. FAST, on the other hand, provides soldiers greater opportunities to enhance their military career while providing little educational credit that is recognized by the civilian sector. For some soldiers, the motivation for participating in a program like TA is to prepare for a career outside the military, so TA could be viewed as a facilitator of separating from the Army. For other soldiers, TA could be viewed as a facilitator to reenlistment because it provides an opportunity to enhance their military experience. These conflicting motives for participating in a program like TA, as well as the potential for such motives to be correlated with both the TA participation decision and the reenlistment decision, highlights the complexity of isolating a program effect on soldier's reenlistment decisions. The following are reasons why one might find a positive (or negative) correlation between TA (and FAST) participation and the probability of retention.

Arguments contributing to a *positive* correlation between program participation and retention:

- Soldiers earn promotion points by earning college credit, and with promotion come benefits (e.g., higher pay) that make the military career more attractive.

- Participating in FAST allows some soldiers greater ability to change MOS, which could increase their desire to remain in the military.

- The TA program helps soldiers to fulfill their educational aspirations while remaining on active duty. Without the TA program, more soldiers might take advantage of the Army's college benefits – such as those made available through the Montgomery GI Bill – by leaving active duty after enlistment completion. Thus, TA enhances the military experience.

- Most simply, the TA and FAST programs are perceived as benefits of continued military service, increasing the value of the member by staying in the Army.

Arguments contributing to a *negative* correlation between program participation and retention:

- College courses provide soldiers with information that is readily transferable to civilian jobs, thus increasing earnings potential in the civilian sector and reducing the incentive to reenlist.

- TA might expose soldiers to a college education, and some soldiers who enjoy the college experience might decide to leave the military to take advantage of their Veterans' educational benefits.

An evaluation of the retention effects of TA and FAST involves determining the extent to which program participation changes soldier behavior. The evaluation attempts to control for different motivations by controlling for soldier attributes that theory suggests might be correlated

with the propensity to participate in programs, the propensity to remain in the military, or both. The following statistical issues must be addressed to accurately determine whether the TA and FAST programs improve retention.

- Because participation in these programs is voluntary, program participants have self-selected to be in the "test" group and are therefore systematically different from soldiers who do not participate (i.e., the "control" group). For example, soldiers with higher academic ability might find TA participation more rewarding compared to soldiers who are academically challenged. If the decision to participate in TA is correlated with the retention decision, then failure to control for self-selection could lead to an inaccurate understanding of the program's retention impact. Some soldier characteristics (e.g., academic achievement) that are hypothesized to be correlated with program participation and/or soldier's propensity to remain in the Army are observable, while other factors (e.g., level of motivation) might be unobservable. The most recent studies of military voluntary education programs controlled for observable soldier characteristics and used statistical techniques to help control for self-selection. For example, Garcia et al. (2002) estimated a probit model that controlled for sample selection bias using the Heckman two-step procedure, while Buddin and Kapur (2002) estimated a bivariate probit model to control for selection bias.

- As discussed by Buddin and Kapur, a major criticism of previous studies is the failure to adequately control for opportunities to participate in voluntary education programs. Military personnel who stay longer are, all else being equal, more likely to participate in voluntary education programs simply because they have greater opportunities to participate. This observation highlights several potential pitfalls when estimating a program participation effect on soldier retention. First, because of the timing during their career of when soldiers have the opportunity to participate in voluntary education programs, it might be preferable to conduct separate analyses on soldiers in their first enlistment compared to soldiers past their first enlistment. Second, the analysis should control for differences in opportunities to participate that vary by soldier circumstances – e.g., location (CONUS versus OCONUS), marital status and number of dependents, and military occupation (e.g., infantry versus an occupation that requires less time in the field). Third, there are potential problems in choosing a program participation measure that is correlated with time (e.g., number of TA credit hours).

Both the approach used to estimate the relationship between participation in TA or FAST and retention and the specification of the forecasting equations build on the more rigorous studies in the research literature. A common longitudinal database provided the information used in both the reenlistment and attrition analyses. We briefly describe the contents of the database and the sources of the information contained in it. Then we discuss the specific data and approach used to conduct the reenlistment and attrition analyses, and the results of these analyses.

Analysis Database

The database used in this analysis contained a longitudinal record of all Regular Army enlisted soldiers who entered the military from FY 1996 through FY 1998, and were stationed at

locations in which automated records of their participation in ACES programs were maintained by the Army in the Education Management Information System (EDMIS) database. A total of 203,630 individuals were initially identified as being in the appropriate accession cohort. Of these, 51,764 were stationed at duty bases in which EDMIS was operational. Records of some of these soldiers were removed because of incomplete or inconsistent data, resulting in an analysis database with 43,831 records.

Data Sources

Data for the ACES evaluation were drawn from the following sources:

- Defense Manpower Data Center (DMDC) Personnel Edit File (PEF) for information on static, unchanging soldier characteristics,
- DMDC PEF for quarterly data on changing soldier attributes,
- DMDC Loss data for separation information,
- EDMIS data for information on ACES participation,
- Servicemembers Opportunity Colleges Army Degree (SOCAD) program data for SOCAD 2- and 4-year contracts (these data were not used in the analysis).
- Selective reenlistment bonus (SRB) multiplier data from Army SRB directives.

DMDC Data

DMDC identified the relevant population of non-prior service accessions during FY 1996-1998 from Military Entrance Processing Command (MEPCOM) data. This resulted in a population of 203,630 soldiers. DMDC provided the following categories of data:

- *Static PEF variables*. The static data consisted of demographic information (e.g., gender, race, date of birth) and data at the time of accession (e.g., AFQT category, education level, accession date).
- *Montgomery GI Bill (MGIB) information*. An additional ASCII file was provided containing MGIB data. Variables included in this file specified whether the soldier was participating the MGIB program.
- *Changing data*. DMDC provided 24 flat files containing changing data from the PEF for each quarter in the period October 1995 through September 2001. The changing data included individual variables that change over time (e.g., marital status, number of dependents, education level) and administrative measures of each soldier's service (e.g., MOS, duty base identifier, pay grade).
- *Loss data*. Separation data were extracted from the DMDC Loss Files. The separation data include the date of the loss, the interservice separation code, eligibility for

reenlistment, and the characterization of military service. There were no more than three separations (which include reenlistments) per soldier for the population at hand.

Education Management Information System (EDMIS) Data

The population of interest for the analysis is those soldiers in the accession cohort who were stationed exclusively at bases for which EDMIS was operational. Thirty-six facilities[10] that became operational on or before October 1997 were selected: 27 of these were operational on or before October 1995, 3 additional on or before October 1996, and 6 more on or before October 1997. Using the DMDC variable "Duty Base Identifier" from the DMDC "changing" data, 51,764 soldiers were identified as serving only in the selected EDMIS-operational facilities. The SSNs for these soldiers were sent to PERSCOM for matching to EDMIS system data from the selected facilities.

The evaluation database includes ACES participation data from the following three EDMIS tables:

- The COLLTAEN table records information on all college enrollments, including the date of the course, number of hours, type of course, cost, and final grade or other outcome.
- The SEPENR table includes information on other ACES educational programs, including FAST, MOSIT, and NCO Leader Skill Enhancement Courses.
- The IND_ALC_TBL table records date and purpose of visits to Academic Learning Centers.

Each EDMIS file contained one record for each COLLTAEN, SEPENR, and/or IND_ALC_TBL "event" for that soldier. EDMIS participation summary indices were created for each soldier in the sample for each of the 24 quarters in the evaluation.

Two- and four- year SOCAD contract data through September 2001 for the EDMIS population were extracted by Servicemembers Opportunity Colleges personnel. HumRRO read these two ASCII files and created a SAS database consisting of SSN and whether the soldier had contracted a 2- and/or 4- year SOCAD agreement.

Selective Reenlistment Bonus (SRB) Multiplier Data

The SRB program was implemented to retain high-quality soldiers with skills that the military considered in short supply. The SRB amount for which a soldier is eligible is an important financial consideration that affects whether a soldier will reenlist. The analysis database includes a variable for each quarter that indicates the SRB multiplier to which each soldier is eligible, based on the soldier's MOS, grade, location, additional skill identifier (ASI), and special qualification indicator (SQI). The value of this variable is based on Army directives

[10] Unique Duty Base Identifiers rather than location names are the basis of this count.

that are issued periodically. The SRB directive in effect for each soldier in each quarter was used to specify the appropriate SRB multiplier.[11]

Final Processing

The individual files described above were merged by soldier identification number to form a single record for soldiers in the evaluation. Each record contains 1,830 variables. Each individual file that contributed to the final merged data was subjected to intra-file consistency and accuracy diagnostic checks. The final merged data were subjected to additional checks that were performed to assess the logical relationship between variables from different sources.

The Reenlistment Analysis

The Analysis Sample

The reenlistment analysis investigated the impact of TA and FAST participation on soldiers' propensity to reenlist. Greater focus was placed on TA participation than on FAST participation because (1) TA is a larger program and more likely to have an effect on retention, and (2) recent studies by Garcia et al. and Buddin and Kapur evaluated TA programs in other military services, which provided estimated program effects for comparison.

The analysis sample consisted of soldiers who began and completed a 3- or 4-year contract during the evaluation period – October 1995 through September 2001. Soldiers with longer contracts (e.g., 4- or 5-year contracts) were more likely than soldiers with shorter contracts (e.g., 2- or 3-year contracts) to be excluded from the analysis sample because their ETS date fell outside the evaluation period. This phenomenon is called right censoring, and results in an over-sampling of soldiers with short contracts. We excluded from our analysis soldiers with 2- or 5-year contracts because of small sample sizes and to better control for opportunities to participate in TA.

To control for differences in opportunity to participate in TA, the bivariate probit model included an indicator of whether the soldier had a 3- or 4-year enlistment. Controlling for contract length variable not only helped control for differences in opportunity to participate in the TA program, but soldiers with longer initial contracts might have had a higher preference for military service. The model also controlled for soldier circumstances such as marital status and career management field (CMF) that can affect the opportunity to participate in TA.

Only soldiers eligible to reenlist were included in the analysis. A soldier was considered eligible to reenlist, for purposes of this analysis, if the soldier had completed at least 2½ years of service and had a 3-year enlistment, or if the soldier had completed at least 3½ years of service and had a 4-year enlistment. Soldiers who had left earlier than 6 months before their initial ETS were included in the attrition analysis, but not the reenlistment analysis. Soldiers who separated before ETS or extended past their ETS had different opportunities to participate in TA.

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[11] If there was more than one directive in effect for a soldier during a quarter, then the one with the largest SRB multiplier was used.

Consequently, this analysis considered TA participation only through the first 2½ years for 3-year enlistments and through 3 ½ years for 4-year enlistments.

Table 4 describes some of the characteristics of the soldiers in the sample. Because the analysis sample is restricted to soldiers who were stationed during their entire first enlistment at installations with an EDMIS system, soldiers at these installations are not a random sample of all first enlistments in the Army. Consequently, the unweighted sample statistics in Table 4 cannot be generalized to the entire Army. Although the simple sample statistics are not representative of the Army, the bivariate probit model estimated to isolate the impact of TA and FAST participation on reenlistment controls for factors such as soldier occupation, demographics, rank, and accession year. These control variables made it possible to obtain a reliable estimate of the impact of TA and FAST participation on reenlistment in our evaluation sample.

As shown in Table 4, the overall sample reenlistment rate was 35%. TA and FAST participation rates were 28% and 21%, respectively. As expected, soldiers with longer contracts had greater rates of participating in TA during their first enlistment compared to soldiers with shorter contracts, in part because they had greater opportunity to participate. Because participation in FAST generally occurs early in one's military career, FAST participation rates were relatively insensitive to contract length after the first two years of service. Soldiers with longer contracts reenlisted at slightly higher rates compared to soldiers with shorter contracts.

Soldiers in higher pay grades at ETS had a higher rate of TA participation and a higher reenlistment rate. Higher pay grade at ETS is likely to be correlated with both contract length and certain soldier attributes (e.g., education level at accession), which in turn are correlated with TA and FAST program participation rates and retention rates.

Female soldiers participated in TA and FAST at higher rates than male soldiers did. In this sample, female soldiers had a slightly higher reenlistment rate than male soldiers, which is the opposite of what is typically seen for the Army as a whole. Married soldiers participated in TA and FAST at slightly higher rates than did single soldiers, and also had a higher reenlistment rate. Black soldiers had higher TA, FAST and reenlistment rates than did white soldiers. Also, soldiers in the "other" race category had higher TA and FAST rates than did white soldiers.

The TA participation rate was higher for soldiers in higher AFQT categories (Category I had the highest rate while Category IV had the lowest rate), while FAST participation rates were higher for soldiers in lower AFQT categories (Category I had the lowest rate while Category IV had the highest rate). Reenlistment rates were negatively correlated with AFQT category.

High school graduates and soldiers with some post-high school education had slightly higher TA and FAST participation rates compared to soldiers with a GED, but had lower average reenlistment rates. TA participation, FAST participation, and reenlistment rates differed by accession year.

Table 4
Unweighted Sample Statistics for Soldiers in the Reenlistment Analysis

Soldier Characteristic	Sample Size	Rate of Participation During First Enlistment		Reenlistment Rate
		TA	FAST	
Overall				
All	10,597	28%	21%	35%
Initial Contract Length				
3 Years	7,762	24%	22%	34%
4 Years	2,835	39%	18%	37%
Grade at ETS				
E1	130	20%	17%	13%
E2	551	18%	15%	23%
E3	4,141	23%	21%	36%
E4	5,642	32%	21%	36%
E5	133	54%	20%	47%
Sex				
Male	9,254	26%	20%	35%
Female	1,343	44%	26%	38%
Marital Status at ETS				
Single	9,170	28%	21%	33%
Married	1,427	30%	22%	46%
Race				
Black	2,874	29%	28%	42%
White	6,494	26%	16%	32%
Other	1,229	33%	28%	36%
Hispanic Ethnicity				
Hispanic	1,234	33%	29%	36%
Non-Hispanic	9,363	27%	20%	35%
AFQT Category at Accession				
I	251	36%	8%	23%
II	2,794	33%	11%	30%
IIIA	2,609	32%	17%	37%
IIIB	4,591	23%	29%	37%
IV	352	19%	31%	44%
Highest Education at Accession				
GED	1,350	24%	14%	42%
HS Graduate	8,663	28%	20%	34%
HS+	584	29%	22%	35%
Accession Calendar Year				
1995	804	28%	27%	29%
1996	4,072	32%	19%	34%
1997	3,675	28%	21%	34%
1998	2,046	20%	15%	41%

Approach

The analytical method that was used is a bivariate probit analysis. A probit analysis is a type of nonlinear regression that is used to predict the likelihood of occurrence of a dichotomous criterion variable. The bivariate probit model allows for the simultaneous prediction of two criteria, in this case TA participation and the decision to reenlist. An important feature of the model is that it allows the criteria to be correlated, thus controlling for selection bias.

The theoretical framework used to understand soldiers' reenlistment decision is a random utility model that highlights the roles of expected utility from remaining (U^R) in the military versus the expected utility from leaving (U^L). One does not directly observe the expected utility of remaining in the Service. One does, however, observe when the expected utility of remaining is greater than that of leaving. Such a positive net utility for remaining would be indicated by the soldier's choice to remain.

The decision to participate in voluntary education programs such as TA can also be described using the random utility model. If the expected utility from participating (U^P) is greater than the expected utility of not participating (U^{NP}), then the soldier is more likely to participate. As with the reenlistment decision, the utility of TA participation (or non-participation) is unobserved but whether the soldier participates is observed.

Mathematically, the two random utility models are specified:

$$\left(U^R - U^L\right)_i = f(\beta_i, X_i)\text{, and}$$

$$\left(U^P - U^N\right)_i = f(\theta_i, Z_i)\text{,}$$

where X and Z are sets of explanatory variables hypothesized to affect, respectively, retention and TA participation. Two vectors of parameters, β and θ, describe the relationship between the explanatory variables and the decisions, respectively, to reenlist and to participate in TA.

The probability of reenlisting and the probability of participating in TA are determined by whether the net utility of each decision is positive, and is described by the following equations:

$$\begin{aligned}\text{Prob(reenlisting)} &= \text{Prob}(U^R - U^L > 0)_i \\ &= \text{Prob}(Reenlist = 1)_i \\ &= \text{Prob}(\hat{\beta}X_i + \hat{\lambda}TA_i + \hat{\lambda}FAST_i + \varepsilon_i > 0).\end{aligned}$$

and

$$\begin{aligned}\text{Prob(TA participation)} &= \text{Prob}(U^P - U^{NP} > 0)_i \\ &= \text{Prob}(TA = 1)_i \\ &= \text{Prob}(\hat{\theta}Z_i + \gamma_i > 0).\end{aligned}$$

The sets of explanatory variables X and Z are as defined previously; *TA* and *FAST* are dummy variables indicating participation in the TA and FAST programs, respectively; and $\hat{\beta}, \hat{\lambda}_1, \hat{\lambda}_2$, and $\hat{\theta}$ are the estimated coefficients describing the relationship between the explanatory and dependent variables. From these equations come testable hypotheses regarding the effect of TA and FAST participation on the probability of reenlisting. The error terms in each equation, ε and γ, are assumed to have the following properties:

$$
\begin{aligned}
E(\varepsilon_i) &= 0, \\
E(\gamma_i) &= 0, \\
Var(\varepsilon_i) &= \sigma_{\varepsilon}^2 \neq 0, \\
Var(\gamma_i) &= \sigma_{\gamma}^2 \neq 0, \text{ and} \\
Cov(\varepsilon_i, \gamma_i) &= \sigma_{\varepsilon,\gamma} \neq 0.
\end{aligned}
$$

Correlation between the two error terms (i.e., $\sigma_{\varepsilon\gamma} \neq 0$) requires using an approach such as the bivariate probit model to prevent estimating a biased value for $\hat{\lambda}_1$. Based on a likelihood ratio test for $\sigma_{\varepsilon\gamma}$, we reject the hypothesis that $\sigma_{\varepsilon\gamma} = 0$ and conclude that estimating a bivariate probit (instead of a single probit) is appropriate.

The typical approach to model reenlistment behavior is to specify an equation that contains the dependent variable (Y), the explanatory variables hypothesized to affect the reenlistment decision (X), and a set of coefficients (β) that describe the relationship between each of the explanatory variables and the dependant variable.

The explanatory variables included in each of the reenlistment and TA participant equations were identified based on a conceptual model of the possible motivations for participating in TA and reenlisting. This conceptual model was developed based on a review of past empirical studies discussed previously. The categories of variables hypothesized to affect the reenlistment decision include: compensation and benefits, quality of life, and soldier demographic characteristics and attributes. In addition, variables indicating participation in voluntary education programs are included to test the hypothesis that program participation influences the retention decision.

- **Compensation and benefits**. If soldiers perceive that their expected earnings (e.g., basic pay, special pays and allowances, and retirement pay) and benefits from remaining in the military are higher than can be received in the civilian sector, then soldiers are more likely to remain in the Services. Soldier pay grade and military specialty at ETS, and the multiplier value for the SRB are included in the retention equation to help account for differences across soldiers in the financial incentives to remain in the Army.

- **Quality of life**. This category of variable typically includes factors such as the hardship associated with frequent or lengthy deployments, the characteristics of one's job, and satisfaction with the Army lifestyle. In general, the more that the quality-of-life factor adds to the soldiers' level of satisfaction (or "utility") the greater the retention effect of that factor. The administrative database from where the analysis samples come contains

few quality of life variables. Our retention equation uses dummy variables for CMF as proxies for quality of life because some occupations are more demanding than others in terms of the hardships placed on soldiers. (Also, opportunities and incentives to participate in TA and FAST might differ by CMF.)

- **Soldier demographic characteristics**. Factors such as race, sex, and level of education might be indicators of potential job opportunities and earnings in the civilian sector. Factors such as marital status might reflect the costs of military hardship on the family (and thus interact with quality-of-military-life-issues), or these factors might be proxies for the services the military provides to families.

- **Participation in voluntary education programs**. To test the hypotheses that participation in TA and FAST affect retention, the retention equation includes dummy variables indicating whether the soldier participated in TA or FAST (e.g., TA and FAST have a value of 1 if the soldier participated, and 0 if the soldier did not participate in the program). We considered using a continuous measure of TA participation (e.g., number of credit hours). Using a continuous measure, however, raised questions regarding the reliability of the credit hours data and which hours should be counted (e.g., completed, currently enrolled). In addition, the use of a continuous independent variable increases the difficulty of controlling for differences across soldiers in opportunities to participate in TA.

Many of these same variables are used in the TA participation equation, although the TA equation does not contain the SRB variable. One variable in the TA equation, but not in the reenlistment equation, is an estimate of per capita expenditures on college education in the state where the soldier is located at the time of ETS. Higher per capita expenditures could indicate a greater emphasis on education in the state and therefore greater opportunities to enroll in college courses. One limitation with using this variable as a proxy for college accessibility is that some soldiers move from one state to another during their first enlistment. The implications of this limitation are likely minor, however, because TA participation is most likely to occur towards the end of the enlistment period. Another instrument considered was the ratio of college enrollment in a particular state to the states' population age 18 to 24. While the first proxy for college accessibility is statistically significant predictor of TA participation, the second proxy was not statistically significant and was omitted from the final analysis.

Individual soldiers are the unit of observation in the analysis, and the soldiers' characteristics are included in the model as either a continuous variable (e.g., age at accession) or a dichotomous "dummy" variable that takes on the value of 1 if the soldier has that characteristic and 0 if the soldier does not have that characteristic. For example, the variable *married* takes on the value of 1 for soldiers who are married at the time of their ETS and the value of 0 for soldiers who are single. The retention variable is coded 1 if the soldier reenlisted and 0 if the soldier separated at ETS. TA and FAST participation are also coded as dummy variables (1=participated, 0=did not participate).

The bivariate probit analysis simultaneously estimates the reenlistment probability equation and the TA participation equation. This statistical process controls for the phenomenon that many of the same soldier attributes that predict reenlistment also predict TA participation.

Results

The main finding of the reenlistment analysis, shown in Table 5, is the estimated 7.6 percentage point increase in reenlistment rates attributed to TA participation, and the 1.4 percentage point increase in reenlistment rates attributed to FAST participation. Note that the TA program effect was substantially lower than the effect reported by Garcia et al. (2002) for the Navy (i.e., 11 to 13 percentage points) but substantially higher than the negative effect found by Buddin and Kapur (2002) for the Navy and Marine Corps. The positive effect is notable, because the analysis controlled for the opportunity to participate in TA, like the analysis of Buddin and Kapur and in contrast to that of Garcia et al. One judge of whether these estimates appear reasonable is to compare them with the reenlistment effect of other military programs. The TA reenlistment effect was roughly equivalent to the effect of a three-level SRB (Hogan et al., 2002; Hansen, 2000), and thus appears high.[12] A one-level SRB typically increases the reenlistment rate by approximately 2 to 5 percentage points, depending on the MOS. Our a priori expectations were for a TA effect that was in the low single digits. For comparison, when we estimated a single probit model with no controls on self-selection in the TA program, we obtained a TA effect of 12%, similar to what was found by Garcia et al.

The FAST participation effect of 1.4 percentage points should be thought of as an upper bound on the true effect because, unlike the TA effect, the bivariate probit model did not simultaneously control for possible self selection bias in who participates in the FAST program. FAST participation was correlated with soldier characteristics such as lower AFQT category and race, both of which are correlated with higher retention. The model did, however, control for these characteristics, which helps eliminate the possibility of omitted variable bias.

The analysis found that being female, non-white, Hispanic, in a higher AFQT category, a high school graduate, having a 4-year versus a 3-year contract, and in a higher grade at ETS had a positive and statistically significant correlation with the likelihood of TA participation.[13] TA participation also varied significantly by CMF. Per capita state expenditures on higher education, which is used as a proxy for accessibility of college-level courses, was positively correlated with TA use and was statistically significant at the 0.01 level.

Statistically significant predictors of higher reenlistment rates, in addition to TA and FAST participation, included SRB level, having a 4-year contract, age, black, male, married, lower AFQT category, having a GED at accession, and pay grade at ETS. Reenlistment rates also varied significantly by CMF.

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[12] The SRB is often paid as a lump sum and is calculated as the product of the SRB level (or "multiple"), monthly basic pay and length of reenlistment contract. A one-level SRB equals one month of basic pay times the number of years of reenlistment

[13] Note that many of these variables are included in the model as "dummy" variables that take on the value of 1 if the soldier has that characteristic, and 0 of the soldier does not have that characteristic. Thus, for example, three measures of highest educational attainment at accession are captured by the use of two dummy variables (GED is measured by GED=1 and Post-high school=0; high school diploma is measured by GED=0 and Post-high school=0; and schooling beyond a high school degree is measured by GED=0 and Post-high school=1).

The marginal effects measure the joint effect of a variable on both TA participation and reenlisting. For example, the positive marginal effect for FEMALE combines the negative effect of being female on the propensity to reenlist and the positive effect of being female on the propensity to participate in TA.

Table 5
Bivariate Probit Results

Variable	Marginal Effect	Reenlistment Equation Coefficient	TA Equation Coefficient	Mean Value
TA participation	.076**	.964**		.279
FAST participation	.014**	.210**		.209
SRB	.006**	.093**		.613
Initial contract is 4 years (reference category is 3 years)	.022**	.149**	.159**	.268
Age at ETS	.0005	.125*	-.004	22.5
Female	.013	-.163**	.347**	.127
Married	.020**	.246**	.028	.135
Black	.023**	.197**	.123**	.271
Other Race	.011**	-.010	.160**	.116
Hispanic	.010	-.042	.180**	.116
AFQT category I (reference category is IV)	-.010	-.494**	.336**	.024
AFQT category II	.000	-.300**	.291**	.264
AFQT category IIIA	.007	-.150**	.242**	.246
AFQT category unknown	.006	.165*	-.062	.033
GED/Equiv. Exam	.014**	.323**	-.099*	.127
Post-high school education	-.014**	.005	-.251**	.055
Grade at ETS is E1 (reference category is E4V)	-.028**	-.613**	-.231	.012
Grade at ETS is E2	-.025**	-.285**	-.299**	.052
Grade at ETS is E3	-.008*	.036	-.160**	.391
Grade at ETS is E5	.054**	.044	.519**	.126
Field Artillery (CMF 13)	.003	-.119**	.160**	.223
Air Defense Artillery (CMF 14)	-.176**	-.115	-.229**	.068
Armor (CMF 19)	-.015**	-.012	-.260**	.057
Signal Operators (CMF 31)	-.002	-.099	.063	.084
Mechanical Maintenance (CMF 63)	-.008	-.121*	-.011	.084
Administration (CMF 71)	.040**	-.211	.690**	.016
Petro and Water (CMF 77)	-.008	-.201**	.058	.053
Transportation (CMF 88)	.020**	.452**	-.138	.040
Supply and Services (CMF 92)	.010	-.049	.187**	.165
Accession year is 1995 (reference category is 1996)	-.017**	-.111*	-.219**	.076
Accession year is 1997	-.001	-.035	.017	.345
Accession year is 1998	.006	.137**	-.037	.193
Intercept		-.975**	-1.039**	
State per capita expenditures for higher education	.00004		.0006**	452

* p < .05; ** p < .01

The Attrition Analysis

An estimated one-third of individuals enlisting in the Army fail to complete their initial enlistment. Although numerous studies have analyzed the causes of attrition in the military, to our knowledge the study by Simutis et al. (1988) described previously is the only study that investigated the effect a continuing education program might have on reducing first term attrition.

One reason for the paucity of research in this area may be that a large percentage of attrition occurs early in the initial enlistment. Consequently, many soldiers who separate early have not had the opportunity to become informed about, or participate in, programs such as TA. The BSEP program evaluated by Simutis et al., a forerunner of FAST, is a program that was available to a soldier early in his or her career, and consequently had the potential for changing a soldiers' likelihood of early separation.

Attrition can occur for numerous reasons, some of which are beyond the military's control. Klein, Hawes-Dawson and Martin (1991) found that most recruits who leave before completing the first 35 months of their enlistment do so for a combination of two or more reasons. The most common reasons for early separation are work or duty problems, training problems, minor offenses, and mental and health problems. Often, these problems are interrelated and confounded by problems with drug and alcohol abuse or a negative attitude. While it seems reasonable to hypothesize that work and training problems can be ameliorated by participation in programs such as TA and FAST, other reasons for attrition will likely be unaffected by TA and FAST participation.

Consequently, it is often useful to construct two working definitions of attrition – "voluntary" attrition and "involuntary" attrition. Voluntary attrition is defined as those separations that are the result of the soldier's actions (e.g., the decision to leave, poor performance or unacceptable behavior). Involuntary attrition is defined as those separations that are not the result of choice (e.g., because of death or for some medical reasons). While some reasons for separation can be classified unambiguously as either voluntary attrition or involuntary attrition, the classification is not straightforward, and may be arbitrary, in many cases. Also, there is some concern as to whether the Army's separation data are sufficiently reliable to separate attrition into meaningful categories. For example, a soldier might receive a medical discharge when the true reason for separating was not medical related. We deleted from our analysis the small number of soldiers who died while on active duty; attrition from all other sources was included.

Approach

Like the reenlistment analysis, the attrition analysis was built on a conceptual model using the random utility framework, but with a time dimension as formulated by Hogan (1979) and Hogan, Smith and Sylwester (1991).[14] The time dimension is important because attrition can

[14] Hogan, Smith and Sylwester (1991) model the effect of the Army College Fund on attrition and reenlistment. They find that supplemental education benefits have only a small effect on contract completion.

occur at any time before the end of a soldier's term of service, while reenlistment occurs at ETS. This model highlights the roles of expected utility from remaining in the military versus leaving, the enlistment contract length, and the "cost" of breaking the enlistment contract. If the net benefits of remaining in the military at time *t* exceed the costs of remaining in the military – including the opportunity cost of working in the civilian sector – then the soldier remains in the military. The soldier has an incentive to break the contract if the utility of remaining is lower than the utility of separating. Also, the longer the soldier must endure a negative net utility – i.e., the greater the remaining term of service – the more likely that soldier is to separate early.

To the extent that programs such as TA and FAST can improve the utility of staying, it can reduce attrition. For example, if FAST allows the soldier to help qualify for a new MOS which in turn improves the soldiers' well being, the soldier is more likely to complete his initial enlistment.

Consider the random utility model where U_t^R denotes a soldier's utility of remaining in the military at time t, and U_t^L denotes the utility in period t from leaving. The utility of remaining and leaving cannot be observed, but attrition behavior reveals when $U_t^L > U_t^R$. Similarly, $U_{y\leq t}^P$ and $U_{y\leq t}^{NP}$ represent, respectively, the utility of participating in TA and the utility of not participating in TA prior to the commencement of the contract year being analyzed.

Following the same notation used in the reenlistment study, the stay/leave decision and the TA participation decision are described by the following equations:

$$\begin{aligned}\text{Prob(continuing)}_{i,t} &= \text{Prob}(U^R - U^L > 0)_{i,t} \\ &= \text{Prob}(\text{Continues} = 1)_{i,t} \\ &= \text{Prob}(\hat{\beta}X_{i,t} + \hat{\lambda}_1 TA_{i,y\leq t} + \hat{\lambda}_2 FAST_{i,y\leq t} + \varepsilon_{i,t} > 0),\end{aligned}$$

and

$$\begin{aligned}\text{Prob(TA participation)}_{i,y\leq t} &= \text{Prob}(U^P - U^{NP} > 0)_{i,y\leq t} \\ &= \text{Prob}(TA = 1)_{i,y\leq t} \\ &= \text{Prob}(\hat{\theta}Z_{i,t-1} + \gamma_{i,t-1} > 0).\end{aligned}$$

The error terms in each equation, ε and γ, are assumed to have the following properties:

$$
\begin{aligned}
E(\varepsilon_{i,t}) &= 0, \\
E(\gamma_{i,t}) &= 0, \\
Var(\varepsilon_{i,t}) &= \sigma_{\varepsilon}^2 \neq 0, \\
Var(\gamma_{i,t}) &= \sigma_{\gamma}^2 \neq 0, \\
Cov(\varepsilon_{i,t}, \gamma_{i,t}) &= \sigma_{\varepsilon,\gamma} \neq 0, \\
Cov(\varepsilon_{i,t}, \varepsilon_{i,t-1}) &= \sigma_{\varepsilon t,\varepsilon t-1} \neq 0, \text{ and} \\
Cov(\gamma_{i,t}, \gamma_{i,t-1}) &= \sigma_{\gamma t-1,\gamma t-1} \neq 0.
\end{aligned}
$$

As with the reenlistment equation, correlation between the two error terms (i.e., $\sigma_{\varepsilon\gamma} \neq 0$) requires using an approach such as the bivariate probit model to prevent estimating a biased value for $\hat{\lambda}_1$. One change from the reenlistment study is caused by the added time element. Because the opportunity to participate in programs such as TA and FAST are correlated with the amount of time in service, the error terms from the TA participation equation are correlated over time. Similarly, because soldiers who separate early in their enlistment are systematically different from soldiers who remain, the sample of soldiers in each years' attrition analysis is systematically different over time. Consequently, the error terms from the continuation equation are correlated over time.

One solution is to conduct separate analyses that look at attrition during different periods of the initial contract. The analysis should control for differences in TA and FAST participation attributed to differences in the amount of time a soldier spends in the Army. The attrition analysis was divided into two parts that investigated whether a soldier broke his or her contract during the first or second year of their contract, respectively. The relatively small number of soldiers separating early during their third, fourth or fifth year prevented us from obtaining reliable estimates of TA and FAST effect on attrition during these years.

Unlike the reenlistment analysis, our preliminary work on the attrition analysis failed to identify an instrument for the TA participation equation that was statistically significant. We attribute the statistically insignificant coefficient on the TA instrument to the extremely small number of soldiers who participated in the TA program during the periods analyzed in the attrition analysis. Like the reenlistment analysis, there is no obvious choice of instrument to model FAST participation using a bivariate probit model. (Note that a viable instrument is a variable that affects TA [or FAST] participation but that does not affect the separation decision). The inability to find a statistically significant instrument led to the decision to model attrition using a simple probit model that predicts the likelihood of staying (value=1) versus separating (value=0) as a function of TA and FAST participation, soldier characteristics, and other factors.

A simple probit model (instead of a bivariate probit) may overestimate of the effects of TA and FAST on attrition because if fails to control adequately for selection bias. The results of the reenlistment analysis suggest that such an overestimate is likely using a simple probit instead of a bivariate probit.

Results

The analysis of first-year attrition included soldiers who completed the first six months of their enlistment. The analysis focused on participation in the TA and FAST programs prior to the cutoff for inclusion in the analysis (i.e., in the first six months of enlistment). Of the 28,516 soldiers in the analysis, only 1% participated in TA and 1% participated in FAST during the first six months of their enlistment (Table 6). The reason for measuring TA and FAST participation before the cutoff period is to help ensure that all soldiers (i.e., those who stay and those who leave) had equal opportunity to participate in the TA and FAST programs. Approximately 11% of the soldiers separated between months seven and twelve of their enlistment, although the separation rate was twice as high for soldiers with a 3- or 4-year contract compared to soldiers with a 2-year contract.

The analysis of second-year attrition included soldiers who completed the first year of their enlistment. In addition, only soldiers with a 3- or 4-year contract were included in the attrition analysis for year 2 because of the difficulty distinguishing an early separation by a soldier with a 2-year contract from a decision not to reenlist. Of the 24,662 soldiers included in the second-year attrition analysis, approximately 7.5% had participated in the TA program during the first year of their enlistment, and 4.5% had participated in the FAST program during the first year of their enlistment. Approximately 18% of soldiers with 3-year contracts and 19% of soldiers with 4-year contracts separated during the second year of their enlistment.

Table 6
Unweighted Sample Statistics for Soldiers in the Attrition Analysis

Contract Year	Sample Size	Rate of Program Participation Through Beginning of Year		Attrition Rate
		TA	FAST	
Year 1 Attrition Analysis (analysis includes soldiers who reach 6 months of service)				
2-year contract	1,677	2%	1%	6%
3-year contract	13,987	1%	1%	11%
4-year contract	12,852	1%	1%	12%
Year 2 Attrition Analysis (analysis includes soldiers who reach 12 months of service)				
3-year contract	12,944	7%	5%	18%
4-year contract	11,678	8%	4%	19%

As with the reenlistment analysis, these unweighted sample statistics cannot be generalized to the entire population of Army enlistments because soldiers in the sample differ systematically from soldiers in the Army as a whole. Nonetheless, the simple probit model controlled for soldier attributes making it possible to obtain a reliable estimate of the impact of TA and FAST participation on attrition in our evaluation sample.

One caveat, through, is that the sample excluded soldiers stationed in OCONUS during their first enlistment because participation data from EDMIS were not available for these

soldiers. Another important caveat is that the likelihood of TA and/or FAST participation in the early stages of a soldier's career is very low. The small sample size of soldiers who participated in these two programs, therefore, reduces the reliability of the findings.

Participation in TA and FAST during the first six months of the enlistment raised the first-year completion probability by approximately 5 and 6 percentage points, respectively (see Table 7). These results were conditional on the soldier completing at least the first six months of their enlistment. Participation in TA and FAST during the first year of the enlistment raised the second-year completion probability by nearly identical amounts (see Table 8). Only soldiers who completed the first year of their enlistment were included in the attrition analysis for year two.

The findings for both programs are statistically significant for both years. As stated previously, however, these results likely represent an upper bound and are based on samples with a very small number of soldiers participating in the programs – especially for the first year attrition analysis. Still, the TA and FAST estimates are remarkably similar for year one and year two.

Discussion

One main finding is that TA participation had a positive and statistically significant relationship with the probability of reenlisting at the end of the first term of service. Our estimate of a 7-percentage point effect is higher than we expected, given results of previous analyses for the Navy and Marine Corps. For comparison, we estimated a 12-percentage point effect when we used a simple probit model without controlling for selection bias. This estimate was similar to the finding reported by Garcia et al. (2002) of an 11% to 13% 6-year retention effect for the Navy's TA program. Our estimate was much higher than the results of Buddin and Kapur's (2002) study, which found that participation in the tuition assistance program actually *lowered* retention rates by 9% for the Navy and by 6% for the Marines. Like Buddin and Kapur, we attempted to control for differences across soldiers in both the opportunity to participate in TA and soldier attributes that are predictors or TA participation and reenlistment.

The marginal effect of TA participation on retention is comparable to other programs – such as the SRB program – that are designed specifically to encourage soldiers to reenlist. For example, a one-level SRB is equal to one month of basic pay times the number of years of reenlistment. This bonus typically increases the reenlistment rate by approximately 2 to 5 percentage points, depending on the MOS (Hogan et al., 2002; Hansen, 2000). Economic theory suggests that soldiers would prefer a cash payment to a non-cash benefit of equal monetary value. The TA reenlistment effect, therefore, would not be expected to exceed the reenlistment effect if the TA benefits were converted to a cash bonus of equal monetary value to what the TA program currently pays.

Participating in the FAST program was estimated to increase reenlistment rates by 1.4%, but this estimate should be considered an upper bound on the true effect because our analysis did not control for possible selection bias in FAST participation unlike the controls used for the TA analysis.

Table 7 Estimated Marginal Effect of TA and FAST on First Year Completion Probability (Conditional on Completing First Six Months of Enlistment)

Variable	Marginal Effect	Probit Coefficient	Mean Value
TA participation	0.060	0.436	0.012
FAST participation	0.061	0.442	0.009
Initial contract is 2 years (reference category is 3 year contract)	0.035	0.216	0.059
Initial contract is 4 years	(0.006)	(0.032)	0.451
Age	(0.002)	(0.010)	21.596
Female	(0.066)	(0.316)	0.147
Married	0.004	0.021	0.124
Black	0.008	0.043	0.252
Other Race	0.026	0.154	0.103
Hispanic	0.025	0.150	0.101
AFQT category I (reference category is IIIB)	0.035	0.219	0.030
AFQT category II	0.021	0.118	0.314
AFQT category IIIA	0.008	0.044	0.304
AFQT category IVA	(0.033)	(0.163)	0.019
AFQT category Missing	0.009	0.054	0.002
GED/Equivalency Exam (reference category is HS grad)	(0.078)	(0.360)	0.106
Post-high school education	(0.018)	(0.094)	0.054
Diver (CMF 00)	(0.521)	(1.575)	0.000
Band (CMF 97)	0.070	0.558	0.001
Field Artillery (CMF 13)	0.022	0.129	0.172
Air Defense Artillery (CMF 14)	(0.052)	(0.248)	0.047
Air Defense Artillery Crewmember (CMF 16)	0.013	0.077	0.003
Armor (CMF 19)	(0.008)	(0.043)	0.066
Air Defense System Maintenance (CMF 23)	(0.042)	(0.204)	0.002
Paralegal (CMF 27)	(0.084)	(0.373)	0.005
Signal Operator (CMF 31)	(0.027)	(0.137)	0.103
Electronic Maintenance and Calibration (CMF 35)	(0.020)	(0.105)	0.009
Psychological Operations (CMF 37)	0.009	0.049	0.001
Parachute Rigger (CMF 43)	0.065	0.495	0.001
Financial Management (CMF 44)	(0.019)	(0.097)	0.000
Artillery Maintenance (CMF 45)	0.023	0.137	0.008
Public Affairs (CMF 46)	(0.081)	(0.362)	0.000
General Engineering (CMF 51)	0.025	0.152	0.002
General Engineering-Other (CMF 52)	0.029	0.178	0.002
Ammunition (CMF 55)	0.023	0.134	0.013
Supply and Services (CMF 57)	(0.006)	(0.035)	0.006
General Engineering Equipment (CMF 62)	0.043	0.287	0.001
Mechanical Maintenance (CMF 63)	0.038	0.237	0.069
Aircraft Maintenance (CMF 67)	0.017	0.098	0.001
Administration (CMF 71)	(0.007)	(0.039)	0.028
Administration-Accounting (CMF 73)	0.008	0.044	0.005
Chemical (CMF 74)	(0.139)	(0.560)	0.003
Administration-Other (CMF 75)	0.045	0.297	0.028
Medical Supply (CMF 76)	0.024	0.142	0.000
Petroleum and Water (CMF 77)	0.036	0.229	0.041
Topographic Engineering (CMF 81)	(0.016)	(0.085)	0.000
Topographic Surveyor (CMF 82)	0.003	0.014	0.007
Transportation (CMF 88)	0.053	0.364	0.032
Medical (CMF 91)	(0.012)	(0.063)	0.003
Supply and Services (CMF 92)	0.027	0.156	0.148
Aviation Operations (CMF 93)	(0.020)	(0.103)	0.006
Military Intelligence (CMF 96)	0.027	0.162	0.001
Signals Intelligence (CMF 98)	(0.316)	(1.054)	0.000
Missing CMF	(0.479)	(1.466)	0.001
Accession Year is 1995	(0.049)	(0.236)	0.043
Accession Year is 1996	(0.028)	(0.145)	0.237
Accession Year is 1997	(0.030)	(0.157)	0.292

* $p < .05$; ** $p < .01$

Table 8 Estimated Marginal Effect of TA and FAST on Second Year Completion Probability (Conditional on Completing First Year)

Variable	Marginal Effect	Probit Coefficient	Mean Value
TA participation	0.047	0.194	0.076
FAST participation	0.057	0.242	0.046
Initial contract is 4 years (reference category is 3 year contract)	(0.010)	(0.040)	0.474
Age	(0.001)	(0.002)	22.618
Female	(0.099)	(0.341)	0.142
Married	(0.022)	(0.081)	0.129
Black	(0.010)	(0.039)	0.257
Other Race	0.040	0.163	0.106
Hispanic	0.034	0.135	0.103
AFQT category I (reference category is IIIB)	0.051	0.217	0.028
AFQT category II	0.031	0.119	0.301
AFQT category IIIA	0.002	0.009	0.292
AFQT category IVA	(0.037)	(0.133)	0.020
AFQT category Missing	0.005	0.020	0.002
GED/Equivalency Exam (reference category is HS grad)	(0.125)	(0.417)	0.107
Post-high school education	(0.049)	(0.174)	0.054
Diver (CMF 00)	(0.240)	(0.714)	0.000
Combat Engineering (CMF 12)	0.145	0.909	0.001
Field Artillery (CMF 13)	0.020	0.080	0.171
Air Defense Artillery (CMF 14)	0.040	0.162	0.046
Air Defense Artillery Crewmember (CMF 16)	0.019	0.077	0.001
Armor (CMF 19)	0.002	0.009	0.061
Air Defense System Maintenance (CMF 23)	(0.029)	(0.107)	0.001
Paralegal (CMF 27)	0.041	0.170	0.004
Signal Operator (CMF 31)	0.014	0.056	0.100
Electronic Maintenance and Calibration (CMF 35)	0.057	0.247	0.009
Parachute Rigger (CMF 43)	0.135	0.789	0.001
Financial Management (CMF 44)	0.061	0.267	0.000
Artillery Maintenance (CMF 45)	0.043	0.180	0.009
Public Affairs (CMF 46)	0.116	0.608	0.000
General Engineering (CMF 51)	0.094	0.453	0.002
General Engineering-Other (CMF 52)	0.094	0.455	0.002
Chemical (CMF 54)	0.076	0.348	0.000
Ammunition (CMF 55)	(0.027)	(0.100)	0.010
Supply and Services (CMF 57)	(0.001)	(0.002)	0.006
General Engineering Equipment (CMF 62)	(0.099)	(0.329)	0.001
Mechanical Maintenance (CMF 63)	0.036	0.147	0.068
Aircraft Maintenance (CMF 67)	0.077	0.352	0.001
Aircraft Maintenance-Other (CMF 68)	0.034	0.137	0.000
Administration (CMF 71)	(0.022)	(0.080)	0.030
Administration-Accounting (CMF 73)	(0.007)	(0.025)	0.005
Chemical (CMF 74)	0.008	0.033	0.003
Administration-Other (CMF 75)	0.045	0.188	0.031
Medical Supply (CMF 76)	0.105	0.530	0.000
Petroleum and Water (CMF 77)	0.025	0.101	0.041
Topographic Engineering (CMF 81)	0.046	0.192	0.000
Topographic Surveyor (CMF 82)	0.017	0.067	0.007
Transportation (CMF 88)	0.065	0.285	0.031
Medical (CMF 91)	0.001	0.005	0.004
Supply and Services (CMF 92)	0.021	0.084	0.152
Aviation Operations (CMF 93)	0.001	0.005	0.006
Military Police (CMF 95)	(0.018)	(0.066)	0.000
Military Intelligence (CMF 96)	(0.008)	(0.032)	0.001
Signals Intelligence (CMF 98)	0.072	0.324	0.000
Missing CMF	(0.456)	(1.265)	0.000
Accession Year is 1995	(0.001)	(0.005)	0.042
Accession Year is 1996	(0.029)	(0.107)	0.229
Accession Year is 1997	(0.030)	(0.112)	0.286

* $p < .05$; ** $p < .01$

Regarding the attrition analysis, we found a 5-percentage point TA program effect and a 6-percentage point FAST program effect on the probability of remaining in the Army during the periods of analysis. The estimates were consistent for the year-one and year-two analyses. The findings should be considered upper bounds as the estimates were obtained through the use of a simple probit model that does not completely control for unobserved attributes of soldiers who participate in TA and FAST, and the possibility that these unobserved attributes are correlated with both program participation and the propensity to separate from the Army. In addition, the findings are based on a relatively small number of soldiers who actually participated in the TA and FAST programs during the initial part of their enlistment.

Because this study focused on soldiers in their first enlistment, the findings cannot be generalized to soldiers in their second or greater enlistment. Soldiers in these later enlistments are systematically different from soldiers in their first enlistment for several reasons. First, reenlistment rates and contract completion rates are substantially higher after the first enlistment, reflecting a population with a higher preference for military life. Second, soldiers with more time in service have greater opportunities to participate in voluntary education programs such as TA and NCO Leader Skill Enhancement courses. Third, on average, soldiers with more time in service will be older, more likely to be married and have dependents, be in higher pay grades.

These findings can be generalized to first-term enlistments in other military services, but with the following caveats. The retention effects of voluntary education programs could differ by military branch because (a) the programs available to military personnel differ by services in terms of program structure and benefits, (b) the deployment situation can differ by military branch (and deployments can affect program participation), and (c) overall attrition and reenlistment rates differ by branch of service.

In summary, turnover is costly to the military. To replace a soldier who separates, the military incurs recruiting costs, training costs, and a loss of experience and skills. Furthermore, when soldiers separate, the military incurs PCS costs, administrative costs to out-process the separating soldier, and lost productivity during the time the soldier is transitioning out of the military. These analyses suggest that the TA and FAST programs have small but statistically significant impacts on reenlistment rates and the probability of contract completion.

EFFECTS OF ACES PARTICIPATION ON PERFORMANCE AND PROMOTION

The analysis of the effects of ACES participation on performance and promotion focused on four programs for which participation data were available: (a) Tuition Assistance, (b) NCO Leader Skill Enhancement Courses, (c) MOS Improvement Training (MOSIT), and (d) opportunities to take the Armed Forces Classification Test (AFCT) offered under the Army Personnel Testing (APT) Program. The programs were evaluated using the following three types of dependent measures: (a) the time in service at which the NCO was awarded his or her current rank, (b) simulated values of the promotion point worksheet for awards and education, and (c) performance ratings. Tailored measures of the latter two types were developed for each program to include the expected benefits of that program, and to avoid confounding the dependent variables with participation measures.

Analysis Data

The performance and promotion analysis was conducted on a database that included the self-reported participation in ACES programs by NCOs (E-4 through E-6), along with administrative information, promotion information, and ratings of the NCOs' performance by their supervisors. The data were collected for an effort (called the NCO21 Validation Project) designed to validate new measures of NCO performance (Knapp, McCloy, & Heffner, 2002). Use of the data collected in the NCO21 Validation Project allowed us to assess the participation in ACES programs and the performance of more experienced soldiers than would be possible from administrative sources. Because automated ACES participation measures were not readily available on EDMIS before 1996, it would be difficult to assess the participation of NCOs in educational programs without considerable time and expense. However, ARI was able to insert several questions into the NCO21 instrument that directly assessed participation in the Army TA Program, the MOSIT Program, and NCO Leader Skill Enhancement courses, as well as whether the respondents had taken the AFCT.[15] In this way, the NCO21 data can provide a cost-effective evaluation of the effects of ACES participation.

The performance measures used in the NCO21 project made it especially appropriate for the current effort. They included an assessment of the information required to simulate a large portion of the Promotion Point Worksheet (PPW) that is used to rank candidates for promotion. Specifically included was information about awards and medals, military education, and civilian education. Because the measures also included direct supervisor assessments of soldier performance on 18 evaluation factors, it was possible to associate ACES participation directly with performance measures rather than relying solely on promotions as a surrogate. Also included in the database was administrative information taken from the Army Enlisted Master File (EMF). These data included demographic information, the accession date, and the date that the soldier attained his or her current rank. Finally, ARI inserted two questions into the data collection instrument that directly asked the NCOs about the extent to which they believed that ACES participation enhanced their performance as a soldier and the degree that the programs improved their competence to perform at the next higher grade level.

[15] Note that the AFCT refers to the Armed Services Vocational Aptitude Battery (ASVAB), when it is given to military servicemembers rather than applicants.

This data source has both advantages and disadvantages when compared to the administrative sources that were used to evaluate attrition and retention, and to those used in previous research. The major advantages relate to the quality of the dependent measures. Previous studies have had to use promotion as a surrogate for performance, because no performance measures existed. The availability of performance ratings on a number of dimensions allowed us to develop performance composites that were tailored to the expected benefits of individual ACES programs. The ability to simulate individual components of the PPW meant that we were able to remove the civilian education component to obtain a promotion measure that was not contaminated by a direct relationship to TA participation.

On the other hand, the data rely on self-reported ACES participation measures. These measures undoubtedly have greater error than administrative measures, and may be subject to biases. Furthermore, there is only limited information about when the soldiers participated in ACES programs. Enrollments in college, career or trade school, or vocational technical education could occur any time since the soldier was on active duty. Participation in NCO Skill Enhancement Courses was specified to have occurred before the solder was promoted to his or her current grade. The date of the most recent Skill Enhancement Course was also identified in the survey.

Data Sources

The data for the performance and promotion evaluation were drawn from the following sources:

- Performance, promotion, and ACES participation data from the NCO21 Validation Project (Knapp et al. 2002).
- DMDC accession files for information about soldier characteristics at the time of accession.
- Army EMF for soldier characteristics at the time of the survey.

The following questions were included in the NCO21 Validation Project questionnaire to assess participation in ACES programs. The range of possible responses is shown in parentheses after the statement of the question.

- How many MOS Improvement/Soldier (Unit) Training Courses sponsored by Army Education have you successfully completed? (0-99)
- How many Army Education NCO Leadership Development Courses did you successfully complete prior to being promoted to your current grade? (0-99)
- When did you complete the last NCO Leadership Development Course prior to being promoted to your current grade? (month on or after 1/90)

- List the total number of semester hours you have earned since you have been on active duty. (recorded separately for career/trade school, vocational technical schools, and college; 0-999 for each type of instruction)

- Of the semester hours you have earned since you have been on active duty, indicate how many were paid for through the Army's Tuition Assistance Program. (recorded separately for career/trade school, vocational technical schools, and college; 0-999 for each type of instruction)

The responses to these questions provided the participation measures used in the analysis.

Most of the other required information was also available from the NCO21 Validation Project. However, some additional administrative information was required from other sources. Data describing soldier characteristics at the time of the survey was extracted from the Army EMF. These data included date of last accession, level of education, race and ethnicity, marital status and number of dependents, and date of expiration of the soldier's term of service. Additional information about soldier characteristics at the time of accession was obtained from DMDC. These data include accession date, education level at accession, marital status, number of dependents, and training MOS. The training MOS was not always recorded in DMDC data, so this variable was not used in later analyses.

Soldier background information, observed performance ratings, and self-reported ACES usage data were merged with updated EMF data and accession data from DMDC to serve as the analysis file for ACES performance analyses. Of the 1,893 soldiers in the database, 114 also appear in the administrative database used in the reenlistment and attrition analyses.

Dependent Measures

The three primary dependent measures used in the analysis are listed and briefly described in Table 9. They are a simulated promotion point worksheet composite, observed performance ratings, and time to current rank. The observed rating measures are only available for soldiers in E5 and E6. In addition to these three measures, we examined the responses to the two questions that directly assessed the NCOs' impressions of the impact of their participation in ACES programs on their competence and performance. Our analysis of these questions was limited to calculating the distribution of responses.

The simulated PPW composite accounted for many aspects of soldiers' military and educational achievements. Because the PPW composite includes measures of civilian education, a new PPW composite was created, removing those measures, for the tuition assistance analysis.

Because not all of the 19 observed ratings are relevant to many of the ACES programs, four different observed rating composites were created that were relevant to the four ACES programs. Table 10 indicates which ratings were used to form the four different composites. PERSCOM representatives who were familiar with the goals and content of the programs selected the ratings to be included. One rating dimension, coordination of multiple units and battlefield functions, was not used for any program, because the supervisors who rated the NCOs in the sample indicated that they had difficulty making the ratings for that factor.

Table 9
Description of Primary Dependent Measures

Simulated PPW Composite

- Considers awards, military education, civilian education, and military training
- Uses the same maximum point values found in the operational version
- Civilian education not considered in evaluating ACES tuition assistance program

Observed Ratings

- Created four composites of supervisor ratings on 19 dimensions of duty performance areas
- Available for E5 and E6 ranks only

Time to Current Rank

- Difference in date between date of current rank and accession date
- Dates come from different sources

Table 10
Observed Ratings Matrix by ACES Programs

Observed Ratings	ACES Program			
	Tuition Assistance	NCO Leader Skill Enhancement Courses	MOSIT Courses	AFCT
MOS/Occupation-Specific Knowledge & Skill		×	×	×
Common Task Knowledge & Skill		×	×	
Computer Skills	×	×	×	
Writing Skill	×	×	×	×
Oral Communication Skill	×	×	×	
Level of Effort & Initiative on the Job		×	×	×
Adaptability	×	×		
Self-Management & Self-Directed Learning Skill	×	×	×	×
Demonstrated Integrity, Discipline, & Adherence to Army Procedures		×		
Acting as a Role Model		×		×
Relating to & Supporting Peers		×		
Cultural Tolerance	×	×		
Selfless Service Orientation		×		
Leadership Skills	×	×	×	×
Concern for Soldier Quality of Life	×	×		
Training others	×	×	×	×
Coordination of Multiple Units & Battlefield Functions				
Problem-Solving/Decision-making Skill	×	×	×	×
Information Management	×	×	×	×

× = Observed ratings to be included in a composite for each dependent measure

Analysis

Because the three primary dependent variables regarding performance and promotion are continuous, the effects of participation in the various ACES programs were determined using multiple linear regression rather than a probit analysis. The analysis differed from the attrition and reenlistment analyses in another important respect, as well. To control for selection bias, the attrition and reenlistment analyses used methods that simultaneously predicted ACES participation and the outcome measure. This approach required the identification of an "instrumental variable" that was related to ACES participation, but unrelated to any of the outcome measures (i.e., performance and promotion). The instrumental variable measured the relative accessibility of the ACES programs to different soldiers. Such a procedure was not feasible in the performance and promotion analyses for several reasons. First, for programs such as AFCT, MOSIT and NCO Leader Skill Enhancement Courses, the variability of access to the programs is minimal, because access is nearly universal. Second, any differences in access that did exist would be minimized by the fact that data were collected from a limited number of locations. Finally, the NCO21 database focused almost exclusively on measures of performance and did not measure access to educational programs.

For these reasons, selection bias was reduced by including observable predictors of participation in the regression as control variables. The analysis assessed the incremental improvement in prediction of the dependent measures provided by participation in ACES programs compared to time in service (or, equivalently, accession date), and other NCO characteristics. If a regression model that includes participation in an ACES program predicts a performance measure significantly better than a comparable model with ACES participation removed, then a relationship between ACES participation and the performance measure is established. The strength of the relationship is measured by the appropriate regression weight.

As described previously, some of the dependent measures were tailored to the ACES program being evaluated. For example, we considered observed performance ratings only for factors that were judged by PERSCOM to be relevant to the program being evaluated. These factors varied with the program being evaluated, necessitating a separate analysis for each program. In addition, evaluation of TA participation did not consider the promotion points that are given for civilian education. Including this factor would have confounded participation with the dependent measure.

We conducted separate analyses for each pay grade for several reasons. First, we expected that promotions at the lower grades would be based more on time in service, and consequently, participation in ACES programs might have a smaller effect at lower grades. Second, participation in some programs, most notably NCO Leader Skill Enhancement Courses, is related to grade. Very few soldiers at the grade E4 have participated in this program, while nearly all soldiers at E6 have. Finally, dependent variables related to promotion points have maximum values that are frequently obtained by more senior NCOs. Consequently, we would expect these dependent variables to provide a more sensitive test at lower grades.

Results

Description of the NCO Sample

This section describes the general characteristics of the NCOs in the sample and the extent to which they participated in ACES programs.

General Characteristics

The NCO ACES Evaluation sample is similar to the total Army E4 through E6 population in terms of gender and race. Like these grades in the Army population for FY 2001, the sample is predominantly male (86%) and white (57%). Soldiers in E5, however, are over-represented in the sample at 47% compared to 32% in the Army population, while E4 soldiers are under-represented. Blacks and women are slightly under-represented in the sample at 27% and 13%, respectively, compared to 30% and 15%, respectively for these grades in the Army population. There is an almost 10-year difference in median age between E4 and E6 soldiers at 23 and 33 years, respectively. This is also true for median years in service, 3 and 13 years, respectively. Table 11 provides a breakdown of Gender, Race/Ethnicity, median age, and median time in service by grade for both

Table 11
Demographics of NCO Sample and Army Comparison Group (number and percentage)

Demographic information	ACES				All Army [1]			
	E4	**E5**	**E6**	**Total**	**E4**	**E5**	**E6**	**Total**
Grade	445 (23.5)	883 (46.6)	553 (29.4)	1893 (99.0)[2]	92,216 (42.5)	69,270 (31.9)	55,323 (25.5)	216,809
Gender								
Male	363 (81.6)	768 (87.0)	494 (89.3)	1633 (86.3)	76,471 (82.9)	58,430 (84.4)	48,646 (87.9)	183,547 (84.7)
Female	76 (17.1)	111 (12.6)	58 (10.5)	247 (13.0)	15,745 (17.1)	10,840 (15.6)	6,677 (12.1)	33,262 (15.3)
Race/Ethnicity								
Black	90 (20.2)	239 (27.1)	181 (32.7)	514 (27.2)	24,399 (26.5)	21,074 (30.4)	19,970 (36.1)	65,443 (30.2)
White	282 (63.4)	501 (56.7)	291 (52.6)	1080 (57.1)	51,931 (56.3)	37,058 (53.5)	27,323 (49.4)	116,312 (53.6)
Hispanic	31 (7.0)	75 (8.5)	37 (16.7)	143 (7.6)	9,899 (10.7)	6,137 (8.9)	3,875 (7.0)	19,911 (9.2)
Other	32 (7.2)	58 (6.6)	40 (7.2)	130 (6.9)	5,987 (6.5)	5,001 (7.2)	4,155 (7.5)	15,143 (7.0)
Age and Time in Service								
Median Age	23.4	27.4	32.9	28.2	No data are available			
Median Years in Service	2.9	6.9	12.6	7.7				

[1] *Data taken from Population Representation in the Military Services*, 2001, Office of the Assistant Secretary of Defense (Force Management Policy)

[2] Does not add up to 100 due to missing data

the ACES sample and the Army population. As the table indicates, the sample is highly representative of the Army enlisted population at each of the pay grades that was included.

Use of ACES Programs

Table 12 and Table 13 provide basic information about participation in ACES programs in the sample. Table 12 shows the percentage of the sample that participated in each program and the average extent of participation over the entire sample. Table 13, on the other hand, focuses on the NCOs who participated in the ACES programs, and presents statistics describing their participation. The TA program is used predominantly for college courses and at much lower rates for career/trade school and vocational/technical school courses. Nearly 50% of those sampled used TA for college courses. E4 soldiers participated in the tuition assistance program at the lowest rate, 20%, and E6 soldiers participated at the highest rate, 77%. Participation among soldiers in E5 was close to, though slightly under the average at 44%. NCOs who participated in TA took an average of over 26 hours (see Table 13), roughly equivalent to one full-time year of college. Again, E4 soldiers who had taken college courses had taken the fewest at 12.5 semester hours, and E6 soldiers had the highest at 37.3 semester hours.

Well over 50% of the soldiers sampled took NCO Leader Skill Enhancement courses (58%). The majority of soldiers in both E5 and E6 participated (69% and 82%, respectively), but only a handful of those in E4 (5%) did so. This large disparity in participation between those in E4 and the other two grades does not hold for MOS Improvement Training (MOSIT) course completion. Almost a quarter of E4 soldiers (23%), a third of E5 soldiers (33%) and 41% of E6 soldiers participated in MOSIT.

Soldiers typically take the Armed Forces Classification Test (AFCT) to qualify for more desirable jobs or other advancement opportunities. Approximately 32% of the sample had taken the AFCT at least once. Soldiers in grade E4 were well below this average, with only 17% participating in the re-testing program. Soldiers in E5 were near the average at just over 32% and E6 soldiers were above the average at 42%. Those who took the AFCT occasionally took it more than once. As Table 13 shows, the average number of times the AFCT was taken was 1.2 for all grades.

Table 12
Participation Rates in ACES Programs by Grade

Program	E4		E5		E6		Total	
Civilian Courses	Percent participation	Average number of semester hours	Percent participation	Average number of semester hours	Percent participation	Average number of semester hours	Percent participation	Average number of semester hours
TA- College	19.9	2.5	44.3	8.5	76.6	28.6	48.1	12.9
TA- Career/Trade	0.0	0.0	0.9	0.2	1.5	0.5	0.9	0.3
TA- Vo/Tech	0.7	0.3	0.7	0.1	2.3	0.5	1.2	0.3
Non-TA- College	12.8	3.5	27.9	6.8	45.8	16.5	29.6	8.8
Non-TA- Career/ Trade	1.4	1.1	2.6	3.4	3.4	1.3	2.6	2.2
Non-TA- Vo/Tech	0.7	0.5	2.0	0.6	2.1	0.8	1.7	0.6
Military Courses	Percent participation	Average number of courses	Percent participation	Average number of courses	Percent participation	Average number of courses	Percent participation	Average number of courses
NCO Leader Skill Enhancement Courses	4.8	0.1	69.2	0.9	82.0	2.0	57.7	1.0
MOSIT Courses	22.5	0.5	32.6	0.9	40.6	1.4	32.4	0.9
AFCT Testing	Percent participation	Average number of tests	Percent participation	Average number of tests	Percent participation	Average number of tests	Percent participation	Average number of tests
AFCT (at least one time)	16.9	0.2	32.2	0.4	42.2	0.5	31.6	0.4

Table 13
Number of Participants in ACES Programs and Extent of Participation by Grade

Program	E4			E5			E6			Total		
Civilian Courses	Semester Hours			Semester Hours			Semester Hours			Semester Hours		
		Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
TA- College	86	12.5	21.0	378	18.0	20.0	410	37.3	31.5	881	26.4	27.9
TA- Career/Trade	0	NA	NA	8	23.9	25.4	8	32.6	33.3	17	27.3	28.3
TA- Vo/Tech	3	41.0	38.5	6	12.0	10.4	12	21.7	16.5	22	21.0	20.0
Non-TA- College	55	27.2	32.4	238	24.4	26.7	244	35.3	25.9	541	29.4	27.4
Non-TA- Career/ Trade	5	41.2	46.1	19	48.0	52.5	17	21.2	16.8	42	35.3	41.4
Non-TA- Vo/Tech	3	66.3	59.1	17	27.7	34.9	11	38.1	23.4	31	35.1	34.6
Military Courses	Courses			Courses			Courses			Courses		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
NCO leader skill enhancement courses	21	1.4	0.8	601	1.3	0.8	446	2.4	2.4	1074	1.8	1.8
MOS improvement courses	98	1.8	1.2	279	2.7	3.0	215	3.4	2.9	594	2.8	2.8
AFCT Testing	Tests Taken			Tests Taken			Tests Taken			Tests Taken		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
AFCT (at least one time)	75	1.2	0.5	282	1.2	0.6	231	1.2	0.6	594	1.2	0.6

NCO Characteristics Related to ACES Participation

We conducted several multiple regression analyses to identify the soldier variables that predict participation in ACES programs. Table 14 lists the unstandardized coefficients and levels of significance for all of the models. The unstandardized coefficients represent the marginal impact of a one unit increase in the predictors on the participation measures. There are several salient features of the results presented in Table 14. Several of the programs have low participation rates, which makes it difficult to predict who will take part in them. For example, the great majority of post-secondary education is supported by TA and involves college courses. Consequently, predictions of career/trade school or vocational/technical school participation are not nearly as good as the predictions of college semester hours, as indicated by the values of R^2 for the regressions.

No single indicator was consistent in predicting participation across all four ACES programs. Pay grade, some college education, and marriage are statistically significant positive predictors of MOS improvement participation. A negative relationship between entry date and MOSIT courses and semester hours of college (both total and from TA) indicates that those who entered the Army earlier were more likely to have participated in those programs. Pay grade and whether or not the soldier is black are predictors of NCO Leader Skill Enhancement Course participation. There was a statistically significant negative relationship in predicting NCO Leader Skill Enhancement Course participation by AFQT percentile, though the effect is slight.

The model is most robust when predicting the number of college semester hours a soldier will take. Pay grade, whether or not a person is black, marital status, AFQT percentile, and gender are all statistically significant and positive predictors of college semester hour load. Date of entry, the number of dependents and whether or not a person is in a combat MOS are all statistically significant, negative indicators of number of college semester hours. Because a smaller (i.e., earlier) date of accession indicates a longer time in service, the negative weight for date of entry indicates a positive relationship between time in service and college semester hours.

Soldiers in combat or combat support MOS were significantly less likely to participate in the TA program than those with a combat service support MOS. In addition, those who entered the Army more recently and those with more dependents had fewer college semester hours earned under TA, while pay grade, gender and AFQT percentile were positive predictors of participation.

Evaluation of ACES Participation

The NCOs were asked the following two questions about the impact of their ACES participation on their competence and performance, with the response options indicated.

Table 14
Regression Weights Predicting ACES Participation Variables

Variables/ Predictors	ACES Program Participation Measure								
	MOSIT Courses	NCO Leader Skill Enhancement Courses	Total Semester Hours: Career/Trade School	Total Semester Hours: Voc/Tech School	Total Semester Hours: College	TA Semester Hours: Career/Trade School	TA Semester Hours: Voc/Tech School	TA Semester Hours: College	Non-TA Semester Hours: Total
R^2 for Regression	.044	.026	.012	.026	.119	.021	.013	.096	.043
Constant	21.9**	-.07	29.09	22.46	510.77**	16.77	-1.50	297.87**	266.69*
Date of Entry	-1.42E-4**	-2.19E-5	-2.08E-5	-2.64E-4	-0.004**	-1.12E-4	1.19E-5	-0.002**	-0.002*
Pay Grade	.22**	.90**	-.16	-.30	13.79**	.13	.11	9.63**	3.46
Some College	.65**	.01	-3.09	-1.04	2.21	-.18	-.22	-5.94	4.42
Less than High School	-.34	.19	7.47**	-.01	-2.86	.13	-.12	-1.45	5.95
Black	.16	.21*	2.53	.37	4.04**	-.40	-.14	1.57	5.90*
Hispanic	-.16	-.04	.45	-.41	1.70	.35	-.34	1.69	.03
Age at accession	-.02	-5.57E-3	.10	.12	.35	7.00E-3	-9.07E-3	.27	.30
Married	.59**	.02	-2.79	-.27	8.04*	-.34	-.04	4.83	.53
Number of dependents	-.17	.06	.79	.51	-3.97*	.20	.02	-3.32*	.43
AFQT Percentile	-5.94E-3	-4.0E-3*	.03	-.02	.09*	-6.13E-3	-2.49E-3	.07**	.04
Female	-.10	-.06	4.68	-.54	7.44**	.45	-.19	8.16**	3.16
Combat	-.21	-.09	-.67	.21	-6.86**	-.16	-.28	-5.85**	-1.03
Combat Support	-.25	-.12	1.40	.87	-2.74	-.04	-.08	-3.02*	2.67

* p # .05; ** p # .01

- To what extent have Army Education programs such as Tuition Assistance, college/vocational-technical courses, and MOS Improvement Courses improved your competence to perform at the next higher grade level?

    - Does not apply: I have not participated in any Army Education programs.
    - Army Education programs have not improved my competence.
    - Army Education programs have slightly improved my competence.
    - Army Education programs have somewhat improved my competence.
    - Army Education programs have greatly improved my competence.

- To what extent have Army Education programs enhanced your performance as a soldier?

    - Does not apply: I have not participated in any Army Education programs.
    - Army Education programs have not enhanced my performance.
    - Army Education programs have slightly enhanced my performance.
    - Army Education programs have somewhat enhanced my performance.
    - Army Education programs have greatly enhanced my performance.

The responses of NCOs who chose the first response option indicating that they had not participated in Army Education programs were eliminated from the analysis of these questions.

Figure 1 shows the results of soldiers' opinions about the impact of ACES participation. Regarding the impact of various ACES program on their competence, 69% of those who participated in ACES programs indicated that the programs had either somewhat (42%) or greatly (27%) improved their competence to perform at the next higher grade level. Responses were more positive for soldiers in higher ranks, who generally had more experience with ACES programs. Thus, while 57% of soldiers in E4 indicated that their competence was somewhat or greatly improved by ACES participation, the comparable figure was 69% for E5 soldiers and 74% for E6 soldiers.

Similarly, regarding whether participation in ACES programs had enhanced their performance as a soldier, 66% indicated somewhat and or great enhancement. Again, those with higher ranks were more positive; 65% of E5 soldiers and 71% of E6 soldiers responded that ACES programs had somewhat or greatly enhanced their performance as soldiers, while 51% of E4 soldiers indicated a comparable level of enhancement.

Separate regression models were developed to evaluate each of the four ACES programs that were tested. The basic modeling strategy was essentially the same for all programs and consisted of two steps. In the first step, several individual variables were included as predictors. The date of accession was used as an indicator of time in service, and hence, the opportunity to participate in ACES programs. It should be noted that a smaller (i.e., earlier) date of accession indicates a longer time in service. Consequently, a negative regression weight indicates that longer time in service predicts greater values for the dependent variables. Several predictor variables assessed the status of the NCO at the time of accession. These variables measure the education level, age, marital status, and number of dependents. Additional predictors represent

Figure 1. Soldier opinion about ACES impact on competence and performance.

the sex, race and ethnicity, and AFQT percentile. Finally, the NCO's MOS was categorized as being in combat, combat support, or combat service support (the reference value). In the second step, participation in the ACES program being assessed was added to the predictors. The significance of the relationship between ACES participation and the dependent variable assessing performance or promotion was determined by the incremental improvement in the variance accounted for by the regression as the participation variable was added. The extent to which participation in the ACES program would be expected to improve performance was assessed by the regression weight for the participation variable.

NCO Leader Skill Enhancement

The independent effects of including the NCO Leader Skill Enhancement Course variable in the model on predicting the simulated promotion point worksheet composite, the observed ratings and the time to current rank are listed in Table 15. Separate analyses were performed for each pay grade. No analysis of observed ratings was possible for those in E4, because soldiers in that grade were not rated. The results indicate that participation in NCO Leader Skill Enhancement coursework does not have an effect on the observed ratings and time to rank. It does, however, predict an increase in PPW composite among soldiers in E4 and E5. Table 16, which shows the regression weights for the analysis, shows that each NCO Leader Skill Enhancement Course taken by an E4 soldier was associated with a 16-point gain in the simulated PPW score. The comparable number for a soldier in E5 was over 8 points. The effect of NCO Leader Skill Enhancement Courses was minimal for E6 soldiers, possibly because nearly all (82%) in grade E6 had taken such a course.

Table 15
NCO Leader Skill Enhancement Program Model

	E4		E5		E6	
	MS	**F**	**MS**	**F**	**MS**	**F**
PPW Composite						
Baseline Model	14929.425	6.007**	72232.593	16.334**	24456.456	6.215**
NCO Leader Skill	12867.320	5.232*	45523.440	10.415**	1075.100	0.273
Residual	2459.234		4371.094		3940.632	
Observed Ratings Relevant to NCO Leader Skill Enhancement						
Baseline Model			0.948	1.356	0.819	1.590
NCO Leader Skill			0.037	0.053	0.406	0.787
Residual			0.700		0.516	
Time to Rank (in days)						
Baseline Model	9037358.522	76.034**	53164371.798	143.328**	28528426.116	53.705**
NCO Leader Skill	143671.574	1.209	551.772	0.001	118715.304	0.223
Residual	118788.403		371398.495		532017.575	

* p # .05; ** p # .01

Table 16 shows that several other factors had a significant effect the three dependent measures used in this analysis. For soldiers in grade E4, those with more time in service had earned more promotion points; they also had taken longer to attain their current rank. Those with a combat MOS had more promotion points than those with other jobs, while women had fewer promotion points than men. Finally, Black soldiers in grade E4 had taken substantially longer to attain their current rank (E4) than their white or other race counterparts.

Table 16
Regression Weights for NCO Leader Skill Enhancement Course Model

	E4		E5		E6	
	B	**Std. Err.**	**B**	**Std. Err**	**B**	**Std. Err.**
PPW Composite						
Constant	2729.182**	475.646	3182.381**	257.346	565.650	315.267
Accession Date	-0.017**	.000	-0.020**	.000	-9.287E-04	.000
Some College at Accession	-20.390	12.173	-23.275*	11.685	-7.430	14.239
Less than High School at Accession	-14.432	8.180	-7.286	7.886	4.194	9.175
Black	7.846	6.490	17.855**	5.717	-.144	6.640
Hispanic	-3.445	9.649	5.251	8.615	25.706*	11.159
Age at Accession	-.743	.982	.334	.920	-2.840**	1.068
Married at Accession	-1.699	11.614	26.356*	10.842	-5.019	10.706
Dependents at Accession	-.997	5.317	-4.824	5.427	-1.670	6.413
AFQT Percentile	.166	.149	.570**	.136	.138	.159
Female	-17.608*	7.118	-5.655	7.428	-20.273*	9.697
Combat	15.323*	6.452	-11.982	6.431	-53.988**	7.389
Combat Support	-.864	6.450	-8.815	6.002	-27.692**	6.900
NCO Leader Skill Courses	15.902*	6.952	8.266**	2.561	.604	1.156

Table 16
Regression Weights for NCO Leader Skill Enhancement Course Model (continued)

	E4		E5		E6	
	B	**Std. Err.**	**B**	**Std. Err**	**B**	**Std. Err.**
Observed Ratings Relevant to NCO Leader Skill Enhancement Courses						
Constant			4.841	3.875	.841	4.299
Accession Date			-1.644-6	.000	3.562E-05	.000
Some College at Accession			-7.994E-02	.193	.252	.212
Less than High School at Accession			1.548E-02	.119	-.114	.123
Black			2.946E-02	.088	3.930E-02*	.090
Hispanic			.284*	.130	.190	.161
Age at Accession			5.673E-03	.015	-3.417E-02	.015
Married at Accession			-.137	.166	.279	.143
Dependents at Accession			8.155E-02	.085	-6.365E-02	.085
AFQT Percentile			5.905E-03**	.002	4.114E-03	.002
Female			-.179	.113	-.204	.137
Combat			-2.742E-02	.097	-.192	.100
Combat Support			-7.768E-02	.090	-.103	.095
NCO Leader Skill Courses			9.110E-03	.040	1.309E-02	.015
Time to Rank (in days)						
Constant	100717.551**	3472.703	97566.595**	2464.410	83804.475**	3663.187
Accession Date	-0.658**	.000	-0.636**	.000	-0.536**	.000
Some College at Accession	-62.901	248.850	-152.410	110.621	-425.078**	165.445
Less than High School at Accession	104.395	58.660	160.787*	73.114	56.997	106.604
Black	164.142*	48.602	-17.074	53.232	18.250	77.151
Hispanic	-40.419	69.593	50.703	80.125	1.296	129.663
Age at Accession	-14.709	8.036	-16.075	9.128	-19.980	12.410
Married at Accession	27.901	98.006	132.725	105.846	57.499	124.395
Dependents at Accession	-57.230	52.708	-69.742	54.545	-42.563	74.520
AFQT Percentile	1.081	1.114	2.913*	1.266	-4.668*	1.843
Female	-1.121	53.404	35.896	69.271	-52.142	112.668
Combat	58.528	46.905	116.120	60.055	-248.055**	85.854
Combat Support	-5.600	47.731	73.252	55.956	-148.462	80.171
NCO Leader Skill Courses	55.769	50.711	.914	23.726	6.347	13.436

* p # .05; ** p # .01

Among soldiers in grade E5, earlier accession dates were associated with more promotion points, as well as a longer time to their current rank. Blacks had more promotion points than other racial/ethnic groups, but no differences in the other dependent variables. In particular, the large difference between Blacks and others groups in time to rank that occurred among E4 soldiers was absent among E5 soldiers. Hispanics tended to have higher performance ratings. Those in grade E5 with higher AFQT scores had more promotion points and higher performance ratings, but took longer to attain their current rank. Soldiers in E5 who were married at accession

tended to have more promotion points, an effect that did not occur for either E4 or E6 soldiers. Finally, those who were not high school graduates took almost half a year longer to attain their current rank than did high school graduates.

The analysis of E6 soldiers revealed some substantial differences in the time to attain this rank. In particular, soldiers in E6 who had some college at the time of accession attained their current rank more than one year earlier than those who did not. Having a combat MOS was also associated with accelerated progression to that rank. The magnitude and direction of the effect of accession date was similar to the comparable value for E4 and E5 soldiers. Finally, those with higher AFQT percentiles attained their current rank more quickly. Several differences were found in other dependent measures, as well. Among E6 soldiers, Hispanics had more promotion points, as did males and those who were younger at the time of their accession. Those with a combat or combat support MOS had fewer promotion points than combat service support MOS (even though those with a combat MOS has been promoted to their current rank more quickly). Finally, Blacks in the grade of E6 had somewhat higher performance ratings.

MOS Improvement Training (MOSIT)

The independent effects of including the MOSIT variable in the model on predicting simulated promotion point worksheet composite, observed ratings, and time to rank are listed in Table 17. The table shows significant effects of this training on the simulated PPW composite for those in E5 and E6, as well as an effect on time to current rank for E5 soldiers. The regression weights shown in Table 18 indicate that participation in MOSIT increased promotion points for both E5 and E6 soldiers about 3 points per course completed. In addition, the data for those in E5 showed nearly a month reduction in time to current rank for each course completed.

Table 17.
MOSIT Program Model

	E4		E5		E6	
	MS	**F**	**MS**	**F**	**MS**	**F**
PPW Composite						
Baseline Model	14305.783	5.735**	71364.063	16.138**	24907.494	6.305**
MOSIT	1394.810	0.559	50644.030	11.605**	19070.05	4.865*
Residual	2497.023		4364.041		3919.962	
Observed Ratings Relevant to MOSIT						
Baseline Model			0.995	1.281	1.233	12.112*
MOSIT			0.055	0.071	0.024	0.041
Residual			0.778		0.586	
Time to Rank (in days)						
Baseline Model	9036477.093	76.149**	53538907.922	145.439**	27903243.745	53.212**
MOSIT	10590.181	0.89	2998497.374	8.221**	382984.218	0.730
Residual	118976.896		364743.396		524670.183	

* p # .05; ** p # .01

The analyses of MOSIT show the same pattern of weights for other predictors as the previous analyses. In fact, the only difference between these analyses is the inclusion of different ACES programs. Consequently, the effects of other variables would not be expected to change much unless these variables were highly correlated with participation in one ACES program, but not with another.

Table 18
Regression Weights for MOSIT Program Model

	E4		E5		E6	
	B	**Std. Err.**	**B**	**Std. Err.**	**B**	**Std. Err.**
PPW Composite						
Constant	2698.960**	479.118	3085.059**	259.459	549.123	317.025
Accession Date	-0.017**	.000	-0.019**	.000	-8.055E-04	.000
Some College at Accession	-18.409	12.175	-25.748*	11.701	-12.688	14.533
Less than High School at Accession	-13.097	8.228	-5.786	7.935	3.296	9.075
Black	9.194	6.504	19.495**	5.722	-1.781	6.682
Hispanic	-3.850	9.720	6.595	8.678	28.039*	11.268
Age at Accession	-.713	.974	.446	.920	-3.010**	1.090
Married at Accession	-5.171	11.651	25.782*	10.857	-3.709	10.609
Dependents at Accession	.597	5.320	-5.520	5.499	-1.231	6.274
AFQT Percentile	.158	.151	.580**	.137	.133	.159
Female	-17.779*	7.198	-3.496	7.426	-20.111*	9.767
Combat	14.814*	6.495	-12.805*	6.462	-54.963**	7.462
Combat Support	-1.012	6.480	-10.477	6.020	-27.063**	6.984
MOSIT Courses	1.233	1.649	3.448**	1.012	2.521*	1.143
Observed Ratings Relevant to MOSIT						
Constant			4.994	4.132	3.269	4.593
Accession Date			-3.671E-06	.000	1.808E-05	.000
Some College at Accession			4.975E-03	.204	.249	.228
Less than High School at Accession			-3.393E-02	.126	-.115	.130
Black			4.618E-02	.093	3.550E-02	.097
Hispanic			.239	.139	.149	.172
Age at Accession			2.687E-03	.016	-4.370E-02**	.016
Married at Accession			-8.748E-02	.177	.257	.148
Dependents at Accession			4.470E-02	.092	-5.972E-02	.088
AFQT Percentile			7.023E-03**	.002	6.722E-03**	.002
Female			-.146	.119	-.242	.146
Combat			6.095E-03	.103	-.198	.107
Combat Support			-6.566E-02	.096	-.137	.103
MOSIT Courses			-4.012E-03	.015	3.558E-03	.017

Table 18
Regression Weights for MOSIT Program Model (continued)

	E4		E5		E6	
	B	**Std. Err.**	**B**	**Std. Err.**	**B**	**Std. Err.**
Time to Rank (in days)						
Constant	100658.568**	3473.773	98804.076**	2458.383	83929.367**	3667.722
Accession Date	-0.657**	.000	-0.644**	.000	-0.537**	.000
Some College at Accession	-66.143	249.048	-125.987	109.933	-452.683**	168.137
Less than High School at Accession	109.024	58.540	157.253*	72.967	44.369	104.989
Black	170.878**	48.086	-26.456	52.813	2.781	77.299
Hispanic	-41.294	69.665	35.179	80.050	11.951	130.367
Age at Accession	-15.137	8.026	-17.007	9.048	-19.422	12.614
Married at Accession	17.015	97.684	158.231	105.308	54.415	122.742
Dependents at Accession	-50.361	52.359	-88.224	54.995	-33.799	72.580
AFQT Percentile	1.077	1.117	2.465	1.262	-4.592*	1.845
Female	-1.451	53.458	42.992	68.688	-31.070	113.002
Combat	54.869	46.922	101.904	59.859	-241.910**	86.332
Combat Support	-10.622	47.776	69.262	55.657	-125.643	80.800
MOSIT Courses	3.451	11.567	-26.914**	9.387	11.296	13.222

* p # .05; ** p # .01

Armed Forces Classification Test (AFCT) Participation under the Army Personnel Testing (APT) Program

The independent effects of taking the AFCT in the model on predicting simulated promotion point worksheet composite, observed ratings, and time to rank are listed in Table 19. (Recall that the AFCT involves a soldier's post-enlistment retest on the ASVAB to qualify for a different job or advancement opportunity). Taking the AFCT has significant effects on the time to rank for soldiers in grade E5, and on the number of promotion points among E4 soldiers. Specifically, as shown in Table 20, E4 soldiers who took the AFCT had about 16 more promotion points than those who did not. However, E5 soldiers who took the AFCT took over 4 months longer to attain their current rank than those who did not. The difference in time to rank can be seen as an indication that the AFCT is serving its purpose to provide advancement opportunities to soldiers who otherwise would not qualify for them. The additional time to rank reflects the time that it takes a soldier to prepare for and participate in the test.

Table 19.
AFCT Participation Model

	E4		E5		E6	
	MS	**F**	**MS**	**F**	**MS**	**F**
PPW Composite						
Baseline Model	14454.942	5.817**	71337.631	16.070**	25102.112	6.375**
AFCT Participation	21197.760	8.693**	303.06	0.068	1797.730	0.456
Residual	2438.401		4444.277		3941.850	
Observed Ratings Relevant to AFCT Participation						
Baseline Model			1.333	1.476	1.150	1.685
AFCT Participation			0.404	0.447	0.232	0.684
Residual			0.904		0.684	
Time to Rank (in days)						
Baseline Model	9044250.258	76.656**	53844156.27	145.307**	28711528.011	55.086**
AFCT Participation	726.116	0.006	4863929.2417	13.329**	1369612.322	2.636
Residual	118318.541		364902.611		519545.541	

* p # .05; ** p # .01

Table 20
Regression Weights for AFCT Participation Model

	E4		E5		E6	
	B	**Std. Err.**	**B**	**Std. Err.**	**B**	**Std. Err.**
PPW Composite						
Constant	2582.059**	474.433	3192.012**	259.425	492.874	314.214
Accession Date	-0.016**	.000	-0.020**	.000	-3.808E-04	.000
Some College at Accession	-19.956	12.038	-22.827	11.703	-8.943	14.531
Less than High School at Accession	-12.556	8.055	-6.925	7.903	3.029	9.072
Black	7.484	6.444	19.993**	5.743	-.463	6.585
Hispanic	-1.437	9.714	5.602	8.634	25.100*	11.145
Age at Accession	-.796	.965	.337	.927	-2.953**	1.068
Married at Accession	-1.999	11.537	26.820*	10.926	-3.089	10.403
Dependents at Accession	-1.969	5.286	-5.269	5.464	-2.362	6.135
AFQT Percentile	.287	.152	.530**	.139	8.279E-02	.169
Female	-17.394*	7.071	-4.847	7.463	-20.776*	9.658
Combat	15.146*	6.365	-12.299	6.456	-55.678**	7.362
Combat Support	-1.593	6.359	-10.069	6.050	-28.127**	6.919
AFCT Participation	15.773**	5.349	.972	3.721	-2.996	4.436

Table 20
Regression Weights for AFCT Participation Model (continued)

	E4		E5		E6	
	B	**Std. Err.**	**B**	**Std. Err.**	**B**	**Std. Err.**
Observed Ratings Relevant to AFCT Participation						
Constant			1.869	4.412	-3.834	4.938
Accession Date			1.644E-05	.000	6.575E-05	.000
Some College at Accession			-7.706E-02	.220	.303	.252
Less than High School at Accession			-3.344E-02	.136	-.105	.140
Black			6.737E-02	.100	2.811E-02	.103
Hispanic			.301*	.148	.231	.185
Age at Accession			3.722E-03	.017	-3.903E-02*	.017
Married at Accession			-.109	.189	.289	.158
Dependents at Accession			8.040E-02	.097	-8.127E-02	.093
AFQT Percentile			6.731E-03**	.002	5.073E-03	.003
Female			-.219	.128	-.216	.158
Combat			-4.447E-02	.111	-.213	.114
Combat Support			-.109	.103	-.142	.110
AFCT Participation			4.416E-02	.070	3.157E-02	.076
Time to Rank (in days)						
Constant	100836.24**	3526.385	96219.641**	2449.940	82888.602**	3607.338
Accession Date	-0.658**	.000	-0.628**	.000	-0.530**	.000
Some College at Accession	-67.263	248.402	-161.858	108.953	-500.357**	166.827
Less than High School at Accession	109.071	57.742	157.422*	72.017	41.592	104.151
Black	170.163**	48.052	-18.008	52.526	4.274	75.599
Hispanic	-53.911	70.420	51.682	78.920	1.751	127.952
Age at Accession	-16.454*	8.023	-16.221	9.039	-17.871	12.264
Married at Accession	18.295	97.569	116.399	104.955	59.043	119.430
Dependents at Accession	-48.552	52.347	-66.195	53.995	-41.203	70.433
AFQT Percentile	1.111	1.139	3.802**	1.275	-3.617	1.939
Female	-.860	53.218	44.018	68.418	-42.152	110.878
Combat	54.773	46.512	106.061	59.251	-233.053**	84.524
Combat Support	-10.772	47.336	81.163	55.445	-127.864	79.436
AFCT Participation	3.440	43.909	128.372**	35.161	82.687	50.928

* p # .05; ** p # .01

Tuition Assistance

In evaluating the effects of TA, we considered civilian education that was supported by TA separately from education that was supported some other way. Thus, the regression model was developed in three steps, rather than the two that were used for the other programs. The first step included the baseline factors, as was the case with the analyses of the previous programs. The second step added the semester hours that were supported by TA as a predictor. The third step added semester hours that were not supported by TA. Table 21 shows that participation in TA had a significant relationship with each of the three dependent measures. Civilian education

that was not supported by TA did not show any significant effects. The lack of a significant relationship between non-TA supported education and the three dependent measures may merely reflect the fact that most civilian education is supported by TA. As shown in Table 22, participation in TA was associated with a significantly higher number of performance points for soldiers in grades E4 and E5. It was also associated with higher observed performance ratings for those in E5 and E6. Finally, it was associated with a shorter time to attain the grade E6.

Table 21
Tuition Assistance Models

	E4		E5		E6	
	MS	**F**	**MS**	**F**	**MS**	**F**
PPW Composite (without civilian education measures)						
Baseline Model	16827.983	9.169**	41319.761	13.265**	12130.970	5.088**
TA Civilian Education	12864.28	7.116**	12542.250	4.041*	3489.340	1.465
Residual	1807.793		3103.381		2382.069	
Non-TA Education	400.190	0.221	1396.630	0.450	7921.760	3.341
Residual	1811.312		3105.491		2371.206	
Observed Ratings Relevant to Tuition Assistance						
Baseline Model			1.029	1.679	0.921	1.707
TA Civilian Education			2.680	3.895*	2.803	5.299*
Residual			0.688			
Non-TA Education			0.033	0.048	0.545	1.030
Residual			0.690		0.529	
Time to Rank (in days)						
Baseline Model	9041198.060	76.575**	53729663.143	147.493**	28501764.892	53.928**
TA Civilian Education	171355.990	1.453	51791.893	0.142	4102364.880	7.866**
Residual	117918.790		364680.393		521522.630	
Non-TA Education	46917.526	0.397	292459.418	0.802	665606.327	1.277
Residual	118120.499		364771.697		521240.112	

* p # .05; ** p # .01

Table 22
Regression Weights for Tuition Assistance Program Model

	E4		E5		E6	
	B	**Std. Err.**	**B**	**Std. Err.**	**B**	**Std. Err.**
PPW Composite (without civilian education measure)						
Constant	2851.779**	407.186	2420.960**	217.778	-343.541	244.381
Accession Date	-0.018**	.000	-0.015**	.000	0.005**	.000
Some College at Accession	-12.324	10.642	-25.009*	9.966	12.685	11.389
Less than High School at Accession	-6.322	6.950	-3.930	6.727	6.550	7.038
Black	9.631	5.549	13.470**	4.818	-7.186	5.147
Hispanic	-2.713	8.270	2.211	7.267	11.516	8.769
Age at Accession	-1.593	.833	-.315	.773	-3.171**	.830
Married at Accession	.996	9.944	11.203	9.163	-6.842	8.123
Dependents at Accession	.797	4.536	.206	4.582	2.827	4.782
AFQT Percentile	9.037E-02	.129	.309**	.114	.131	.122

Table 22
Regression Weights for Tuition Assistance Program Model (continued)

	E4		E5		E6	
	B	**Std. Err.**	**B**	**Std. Err.**	**B**	**Std. Err.**
Female	-21.433**	6.147	-15.970*	6.345	-23.754**	7.522
Combat	15.465**	5.475	-4.712	5.402	-27.521**	5.843
Combat Support	-7.671	5.497	-7.424	5.067	-14.059**	5.380
TA Semester Hours	.449**	.170	.174*	.086	.120	.074
Non-TA Semester Hours	-4.162E-02	.089	2.770E-02	.041	.131	.072
Observed Ratings Relevant to AFCT Participation						
Constant			5.175	3.840	2.353	4.308
Accession Date			-5.644E-06	.000	2.285E-05	.000
Some College at Accession			-2.661E-02	.195	.352	.216
Less than High School at Accession			4.197E-02	.120	-7.100E-02	.123
Black			7.127E-02	.087	5.884E-02	.091
Hispanic			.251	.131	9.390E-02	.163
Age at Accession			7.599E-03	.015	-3.577E-02*	.015
Married at Accession			-.176	.166	.239	.140
Dependents at Accession			.115	.085	-3.940E-02	.082
AFQT Percentile			6.796E-03**	.002	5.224E-03*	.002
Female			-7.155E-02	.112	-.176	.139
Combat			-1.800E-03	.097	-.146	.104
Combat Support			-6.037E-02	.090	-8.114E-02	.098
TA Semester Hours			4.311E-03*	.002	2.705E-03*	.001
Non-TA Semester Hours			-1.637E-04	.001	-1.239E-03	.001
Time to Rank (in days)						
Constant	100607.250**	3455.471	98103.220**	2452.606	84822.309**	3623.278
Accession Date	-0.657**	.000	-0.639**	.000	-0542**	.000
Some College at Accession	-75.494	248.271	-147.215	110.865	-470.204**	168.859
Less than High School at Accession	101.075	57.931	160.864*	73.352	43.684	104.350
Black	169.188**	47.848	-24.465	52.694	24.931	76.313
Hispanic	-39.970	69.394	40.861	79.478	26.794	130.008
Age at Accession	-15.139	8.007	-16.407	9.017	-19.534	12.311
Married at Accession	13.548	97.403	133.861	105.176	83.006	120.429
Dependents at Accession	-49.825	52.166	-70.184	54.182	-61.746	70.896
AFQT Percentile	1.234	1.115	2.597*	1.246	-4.683**	1.807
Female	.707	53.212	45.285	69.504	-28.317	111.530
Combat	50.172	46.396	112.936	59.300	-322.437**	86.633
Combat Support	-7.016	47.508	80.232	55.559	-178.275*	79.766
TA Semester Hours	-1.856	1.513	.340	.960	-3.274**	1.093
Non-TA Semester Hours	-.794	1.260	-.402	.449	-1.202	1.063

* p # .05; ** p # .01

Practical Implication of ACES Participation

The practical implication of these analyses is that the ACES tuition assistance program, MOSIT courses, and NCO Leader Skill Enhancement courses can have a real impact in improving soldiers' promotion point scales and performance ratings, as well as in decreasing their time to rank. Table 23 shows that among soldiers in grade E4, 15 semester hours of tuition assistance predicted an increase in soldiers' PPW composite of nearly 7 points. Among E5 soldiers, 15 semester hours of tuition assistance was associated with more than half a point increase in the ratings of their performance by supervisors (on a 7-point scale). Among soldiers in grade E6, 15 semester hours of tuition assistance was associated with a decrease in time to rank by nearly a month and a half.

Table 23
Effects of 15 Semester Hours of ACES Tuition Assistance

Pay Grade	Variable	PPW Composite (in points)	Composite Rating (in points)	Time to Rank (in days)
E4	Effect of TA	6.7**	NA	-27.8
	Criterion Mean	114.1	NA	860.0
	Criterion SD	47.5	NA	655.6
E5	Effect of TA	2.6*	0.65*	5.1
	Criterion Mean	210.6	4.93	2042.3
	Criterion SD	60.9	0.84	1076.5
E6	Effect of TA	1.8	0.04*	-49.1**
	Criterion Mean	289.3	5.31	3588.4
	Criterion SD	52.1	0.75	1083.8

Note: Effect of TA was obtained by multiplying the appropriate unstandardized regression weight by 15.
* p# .05; ** p# .01

Likewise, the effect of a soldier taking a single MOSIT course was associated with a predicted increase in promotion point scales and a decrease in time to rank, though predominantly for those in E5. Among soldiers in grade E5, taking one MOSIT course was associated with an increase in their PPW composite by 3.4 points and a decrease in his or her time to rank by nearly a month. As Table 24 indicates, the effects of one MOSIT course were smaller for soldiers in grades E4 and E6 on both the PPW composite and time to rank. No effects were found on the composite rating.

Table 24
Effects of One MOSIT Course

Pay Grade	Variable	PPW Composite (in points)	Composite Rating (in points)	Time to Rank (in days)
E4	Effect of TA	1.2	NA	3.5
	Criterion Mean	123.0	NA	860.0
	Criterion SD	53.4	NA	655.6
E5	Effect of TA	3.4**	- 0.00	-26.9**
	Criterion Mean	233.0	4.89	2042.3
	Criterion SD	74.0	0.89	1076.5
E6	Effect of TA	2.5*	0.00	11.3
	Criterion Mean	348.7	5.31	3588.4
	Criterion SD	67.2	0.81	1083.8

* p# .05; ** p# .01

Finally, Table 25 shows that participation in an NCO Leader Skill Enhancement course was associated with a substantial increase in the PPW composite for soldiers in E4 and E5, with a predicted effect of 16 and 8 points, respectively. Other differences shown in the table were not significantly different from zero.

Table 25
Effects of One NCO Leader Skill Enhancement Course

Pay Grade	Variable	PPW Composite (in points)	Composite Rating (in points)	Time to Rank (in days)
E4	Effect of TA	15.9*	NA	55.8
	Criterion Mean	123.0	NA	860.0
	Criterion SD	53.4	NA	655.6
E5	Effect of TA	8.3**	0.01	0.9
	Criterion Mean	233.0	5.03	2042.3
	Criterion SD	74.0	0.84	1076.5
E6	Effect of TA	0.6	0.01	6.3
	Criterion Mean	348.7	5.40	3588.4
	Criterion SD	67.2	0.74	1083.8

* p# .05; ** p# .01

SUMMARY AND CONCLUSIONS

Although previous studies have evaluated the impact of continuing education (CE) programs on reenlistment and promotion for other Services, this study is the first major evaluation of the ACES program. This present study was made possible by the recent creation of a centralized and detailed record of participation in various ACES programs. The development of the EDMIS system allowed us to obtain automated records of participation in ACES programs. By FY 1996, EDMIS was available at enough locations to allow us to follow a large portion of the accession cohorts for that year and the following two years through their first term of service. Since approximately 20% of the soldiers in this three-year cohort were assigned to locations that had EDMIS from the time of their accession through the end of FY 2001, we obtained a sufficiently large sample to perform relatively sensitive tests of the effects of participation in ACES programs on retention and performance.

The survey data from the NCO21 Validation Project (Knapp et al., 2002) allowed the evaluation to cover a wider range of dependent measures than previous studies. Previous research has usually relied on promotions as a surrogate for performance. However, promotions have several problems, not the least of which is the fact that civilian education has a direct effect on promotion, through the promotion points system. Use of the NCO21 database allowed us to improve upon previous efforts in two ways. First, the data included detailed performance ratings of several dimensions of NCO performance. Performance ratings of this quality and level of detail have not been available to any previous study. Second, the promotion points worksheet was represented with sufficient detail so that we could remove any points that were directly awarded for civilian education, thus eliminating the confounding between participation and promotion.

Summary of Results

The results of the analyses are almost uniformly favorable to the ACES programs that were examined. We briefly summarize these results by program.

Tuition Assistance (TA) programs, because they are the most costly of CE programs, and because of their relatively high participation rate and the ease of obtaining participation data, have been the primary focus of previous evaluations. The results of these studies have been mixed, with earlier studies showing large effects of participation in TA on retention and promotion, but more recent and better controlled studies showing no effects or even negative effects on reenlistment. The current study has found statistically significant positive effects of TA participation on reenlistment and attrition, as well as effects on performance and promotion variables. Specific effects of participation in TA include the following:

- Participation in TA was associated with a 7-percentage point increase in the likelihood that a soldier would reenlist at the end of his or her first term of service.

- Participation in TA increased the likelihood that a soldier would complete the first year of service (conditional on completion of 6 months) and second year of service (conditional on completion of the first year) by 5 percentage points. This finding should be considered

an upper bound on the estimated effect, because the analysis only partially controlled for selection bias.

- NCOs of rank E5 and E6 with a greater number of semester hours supported by TA also received higher performance ratings from their supervisors.

- NCOs who participated in TA tended to have more promotion points, exclusive of those received directly for their civilian education. Fifteen semester hours of civilian education supported by TA was associated with increases of 6.7, 2.6, and 1.8 points for NCOs in rank E4, E5, and E6, respectively.

- Participation in TA was associated with earlier promotion to the rank of E6.

Thus, participation in TA had a salutary effect on all of the dependent measures that were considered.

This study estimated the effect of the Functional Academic Skills Training (FAST) program on attrition and reenlistment. FAST participation was associated with a small but statistically significant increase (1.4 percentage points) in reenlistment likelihood. However, it was associated with a fairly substantial, 6-percentage point decrease in annual attrition probability across the first two years of service. These estimates should be considered upper bounds on the true effects, because the analysis only partially controlled for selection bias.

The remaining ACES programs were associated with increases in promotion points, although there were also some effects on time to current rank. With one exception, the effects on promotion points were positive, though they were not statistically significant at each pay grade. Effects on time to rank were both less common and less consistent. With the exception of TA, none of the evaluated programs had a significant effect on observed performance ratings.

Participation in the remaining three ACES programs included in this evaluation had the following effects.

- Participation in NCO Leader Skill Enhancement Courses was associated with a larger number of promotion points. This difference was present for all ranks, but was statistically significant for soldiers in grades E4 (15.9 points per course) and E5 (8.3 points per course).

- Participation in the MOS Improvement Training (MOSIT) Program was also associated with greater number of promotion points. This effect was smaller than the comparable effect for NCO Leader Skill Enhancement Courses, but was significant for those in E5 (3.4 points per course) and E6 (2.5 points per course).

- NCOs at the rank E5 who had participated in MOSIT also took a shorter time to attain their current rank. The magnitude of this difference was approximately 26.9 days per course.

- E4 soldiers who took the AFCT had a greater number of promotion points (15.8 points per retake) than those who did not.

- NCOs who took the AFCT also took longer to attain their current rank. The difference was in the same direction for all pay grades, but was only statistically significant for those in E5 (128.4 days per retake). The difference in time to rank can be seen as an indication that the AFCT is serving its purpose to provide advancement opportunities to soldiers who otherwise would not qualify for them.

Implications of the Results

The magnitude of the positive effects of participation in TA on reenlistment was somewhat surprising, given the results of the recent analysis by Buddin and Kapur (2002) who found that TA participation in the Navy and Marine Corps had a small negative impact on reenlistment rates. Although the results of our analysis are more modest than the results of earlier studies that failed to control for differences in opportunity to participate (e.g., Garcia et al., 1998), we still have found a substantial and statistically significant positive effect of TA participation on reenlistment. Furthermore, we controlled for both selection bias and differences in the opportunity to participate in TA using much the same methods as employed by Buddin and Kapur. It is possible that the differences in findings arise from differences in the evaluation data between their analysis and this one. For example, this analysis excluded soldiers with overseas assignments, because their participation in ACES programs was not documented in EDMIS, while the analysis of Buddin and Kapur included these servicemembers. In addition, Buddin and Kapur focused on TA usage in the 24 months before the end of the term, while the current analysis considers all participation before the last 6 months of the term. It is also possible that the discrepancy between results reflects differences between characteristics of the military services, although there is little evidence regarding what these differences may be. Clearly, it will take further analyses to reconcile these differences.

Another useful goal for additional analyses would be to determine the effectiveness of controls for selection bias and to identify better control methods, particularly for the attrition analysis. In attempting to estimate the TA program effect on reenlistment probability, we controlled for two potential sources of bias. First, we controlled for differences in opportunities to participate in the TA program, including both differences related to time (i.e., soldiers with more time in the Army have greater opportunity to participate than do soldiers with shorter time in the Army), and differences related to location (i.e., opportunities to participate in TA and access to college courses might differ by installation). Second, we controlled for selection bias, which is the possibility that soldiers who participate in TA might systematically differ in their propensity to reenlist compared to soldiers who do not participate in TA, for reasons unrelated to TA participation. Because of the complexity of adequately controlling for unobservable soldier attributes (e.g., motivation or level of support from peers and superiors to participate in TA), it may be possible to improve the accuracy of the results by enhancing the effectiveness of the controls used.

The databases used in this evaluation provided two views of soldiers at different points in their career. The administrative data used to investigate attrition and reenlistment issues was a longitudinal database that tracked soldiers through their first term of service with quarterly

snapshots. The survey-based data used to examine promotion and performance, taken from the NCO21 Validation Project (Knapp et al., 2002), provided a single cross section of NCOs with up to 20 years experience. Each of these types of data has advantages and disadvantages. In addition, the specific nature of the databases that were used presented some challenges to analysis and interpretation.

The administrative database used for attrition and reenlistment analysis was limited by the times and locations at which EDMIS was available. Our selection of the FY 1996-1998 cohorts was based on the earliest availability date of automated participation data in EDMIS. During these years, EDMIS was limited to approximately 30 large CONUS bases. Despite this restriction, more than 20% of the soldiers in the combined cohort were stationed at one of these bases throughout the period examined in the study. Although the composition of the analysis sample may differ in several respects from the Army enlisted population, the analysis models were developed to isolate the impact of ACES participation, controlling for factors such as soldier occupation, demographics, rank, and accession year. These control variables made it possible to obtain a reliable estimate of the impact of ACES participation in our analysis sample.

However, the overall estimates of the reenlistment and first-term attrition rates based on the sample should not be taken as estimates for the Army as a whole. These numbers would need to be adjusted to reflect the distribution of the Army enlisted population. Although, adjustments could be made for demographic characteristics, MOS, grade and other variables, other factors could not be considered, because they were not represented in the analysis sample. In particular, because only CONUS locations had access to EDMIS, the sample we evaluated did not include soldiers who were assigned overseas during their first term of service. This fact limits the accuracy of population estimates of reenlistment and attrition rates, but has a minimal effect on the estimate of the effect of ACES participation on these rates.

As the use of EDMIS has expanded to a larger number of locations, the limitations of its use as a data source have decreased. We anticipate that future analyses based on later cohorts will be able to consider a more representative sample of the enlisted population and to produce more accurate estimates of population reenlistment and attrition rates. It will also be able to address the interesting questions of access to and effects of ACES programs among soldiers who are assigned overseas.

The NCO data used for the performance and promotion analysis was collected as a part of the NCO21 Validation Project (Knapp et al., 2002), and adapted by adding several variables describing administrative information about the respondents. This database provided a unique opportunity to examine actual performance ratings by supervisors, rather than relying solely on a surrogate measure, such as promotions. However, there are some limitations with this source of data, as well, because it includes limited information about when education took place and comes from a relatively small sample of NCOs. The NCOs were asked fairly limited questions regarding when they participated in educational programs. Information about the pattern of participation over time could not be determined from these data. This fact can have an effect on the accuracy of the analysis of time to current rank, because some of the ACES participation (particularly TA) may have occurred after the current rank was awarded. In addition, the sample size limits the magnitude of the effects that can be identified. This factor appears not to have

been excessively limiting in the current analysis, as several of the statistically significant effects were of moderate size.

Future studies should combine survey and performance data with participation data from administrative sources. This would improve the accuracy of the participation data while maintaining the advantages of the supervisor ratings and detailed promotion point information. The continued development of EDMIS should make such a study possible in the relatively near future.

The results of this study provide information that could form the basis for a cost-benefit analysis of ACES programs. This activity would be the natural next step in evaluating ACES programs. Benefits of reduced attrition or increased likelihood of reenlistment have clear cost implications in that they decrease the need for recruiting, accessing, and training soldiers to replace those who separate. The benefits of increased promotion rate would be somewhat more difficult to assess in monetary terms. Such a cost-benefit analysis would quantify these and other benefits of ACES participation in monetary terms, so that they could be compared to the associated costs. The cost to the Army of participation would also be determined on either a per-course or per-participant basis. Cost estimates should consider all relevant costs including an allocated portion of administrative costs. A further task would be to compare ACES programs to other programs that affect retention or performance or improve the quality of life for Army enlisted personnel.

The results of a cost-benefit analysis of ACES participation are impossible to forecast. Garcia et al. (1998) showed clear cost-effectiveness for both college participation and academic skills training for Navy enlisted personnel, but these results were based on substantially larger estimates for the improvements in attrition due to participation than were found in the current study. Furthermore, there are differences between the Army and the Navy in the accession and training pipeline that make interservice comparisons difficult. The existence of these differences underscores the importance of conducting a cost-benefit analysis.

One category of benefits for ACES, its effect on the ease of recruiting high quality youth, was not addressed at all in this research. There is circumstantial evidence that educational programs such as those provided by ACES might encourage high-quality youth to enlist. Recruit surveys typically indicate that educational benefits are one of the most important reasons for enlistment. In addition, participants in ACES programs, particularly in TA, tend to have better qualifications than soldiers that do not participate. These findings suggest the possibility that educational programs such as ACES may provide a recruiting benefit. However, considerable additional research must be conducted to determine the magnitude of the effects of educational programs on recruiting and to separate the effects of programs like ACES, which are used when the soldier is serving, from programs that are primarily used after the soldier has separated.

The results reported here suggest beneficial relationships between participation in ACES programs and unit readiness. Critical to unit readiness is an available pool of soldiers with the skills needed to perform effectively the duty requirements determined by operational missions. The results of this analysis show that ACES programs contribute to development of the needed pool of capable soldiers. To recap, participation in ACES programs was positively related to personnel availability in terms of attrition and reenlistment (retention) and to individual

performance effectiveness as reflected in time to promotion, self-reported assessments, and supervisor evaluations. While these results were obtained for today's Army, this beneficial relationship may become even more important for the Army as it transforms toward the Objective Force. This emerging force is projected to require soldiers who are committed to life-long learning. Projections also indicate that to a greater extent than today, this learning will occur through self-development activities. Thus, this study's results go beyond simply showing the positive effects of voluntary participation in ACES programs on the personnel ingredients of unit readiness. They further imply that ACES provides the types of self-development programs that can allow the Army to achieve transformation and support the transformed Army in sustaining its effectiveness.

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LIST OF ACRONYMS

ACES	Army Continuing Education System
AFCT	Armed Forces Classification Test
AFQT	Armed Forces Qualification Test
APT	Army Personnel Testing
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
ASI	Additional Skill Identifier
ASLC	Academic Skills Learning Centers
BSEP	Basic Skills Education Program
CCAF	Community College of the Air Force
CE	Continuing Education
CMF	Career Management Field
DMDC	Defense Manpower Data Center
DoD	Department of Defense
EDMIS	Education Management Information System
EMF	Enlisted Master File
ESL	English as a Second Language
ETS	Expiration of Term of Service
FAST	Functional Academic Skills Training
FFGE	Fully Funded Graduate Education
GED	General Equivalency Diploma
MEPCOM	Military Entrance Processing Command
MGIB	Montgomery GI Bill
MOS	Military Occupational Specialty
MOSIT	Military Occupational Specialty Improvement Training

NCO	Noncommissioned Officer
PACE	Program for Afloat College Education
PEF	Personnel Edit File
PERSCOM	U.S. Total Army Personnel Command
PCS	Permanent Change of Station
PPW	Promotion Point Worksheet
PRS	Participation Reasons Scale
SOCAD	Servicemembers Opportunity Colleges Army Degree
SQI	Special Qualification Indicator
SRB	Selective Reenlistment Bonus
TA	Tuition Assistance
VOLED	Voluntary Education